Library
TS
227
.R1
W39

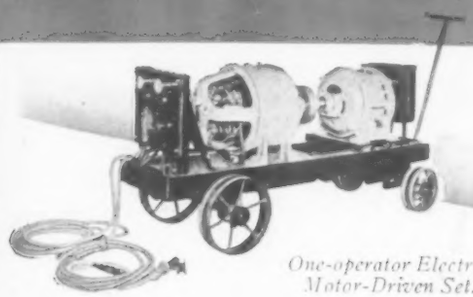
# The Welding Engineer

Reg. U. S. Pat. Office

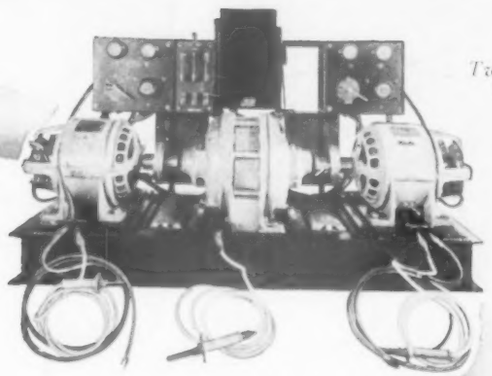
Founded by L. B. Mackenzie, 1916

JANUARY, 1930 VOL. 15, NO. 1

$3.00 per year in U. S. 608 S. Dearborn St., Chicago, Ill $4.00 per year abroad

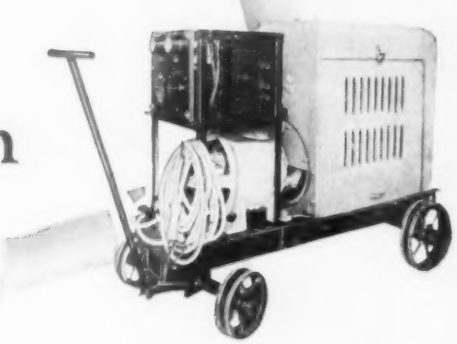


One-operator Electric-Motor-Driven Set.



Two-operator Electric-Motor-Driven Set.

## Simple Operation
## Close Control
## Perfect Commutation

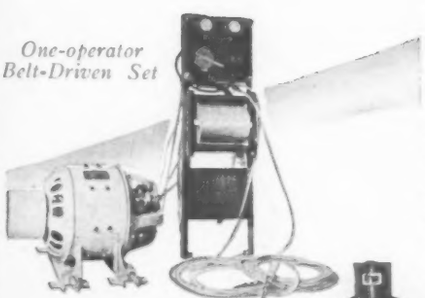


One-operator Gasoline-Engine-Driven Set.

PRACTICALLY every industry is profiting by the simple operation, close control and perfect commutation of Wilson Machines. As a result of their closer control of welding current, they

**—operate easier**
**—make better welds**
**—permit greater output**

There is a complete line of Wilson hand-operated arc welders for shop and field requirements—one-operator machines, supplied in Type 100, Type 200, Type 300 and Type 400 Ampere capacities; two-operator machines, supplied in Type 400, Type 600 and Type 800 Ampere capacities. Write today for bulletins.



One-operator Belt-Driven Set

***Whatever YOUR industry ~whatever YOUR metal-joining problem ~investigate* ARC-WELDING**

WILSON WELDER & METALS CO. INC., 20 WILSON BUILDING, HOBOKEN, N. J.

# WILSON

## WELDING MACHINES AND WELDING WIRE

*Published monthly by the Welding Engineer Publishing Co. Entered as second class matter Jan. 20, 1916, at the Post Office at Chicago, Ill., under the Act of March 3, 1879.*

# ARMCO
# INGOT IRON

## the uniform welding metal

*Welders like to work with ARMCO Ingot Iron. Being pure and uniform, it flows smoothly and unites in sound, even welds. And the joint is sure to be strong and durable.*

**WHAT you will like about ARMCO Ingot Iron most of all is its pronounced uniformity. Throughout each sheet or plate, and shipment after shipment, it is consistently the same — a uniformly pure, dense, weldable iron.**

**Your time-and-labor costs are appreciably lower. ARMCO Ingot Iron works freely and surely, welds rapidly and soundly. Especially when you use welding rods and electrodes made of this same pure iron.**

**Your customers will be better satisfied, too. ARMCO Ingot Iron is well known for its rust-resistance. It has the longest record of *actual service* of any low-cost, rust-resisting sheets and plates.**

**Any of the offices listed below will work with you in solving your particular problem. Call on them.**

Hear the famous
ARMCO CONCERT BAND
every Tuesday night
WLW - 700 K. - Cincinnati
Ten to eleven E.S.T.

*Back of this familiar symbol is nearly thirty years experience in the manufacture of special analysis iron and steel sheets and plates. When you want a durable, weldable, low-cost metal be sure to see this triangle and the words, "ARMCO Ingot Iron." It assures you shop economies and dependable, economical service for your customers.*

## THE AMERICAN ROLLING MILL COMPANY

**Executive Offices, Middletown, Ohio**

**Export: The ARMCO International Corporation**

DISTRICT OFFICES: Chicago, Cincinnati, Cleveland, Detroit, New York, Philadelphia, Pittsburgh, St. Louis, San Francisco

E. Engin. Lib.

# The Welding Engineer

Founded by L. B. Mackenzie, 1916

Volume 15 | January, 1930 | Number 1

CONTENTS

Welding in 1929 and 1930 ..... 35
Trend Toward Welded Constructions ..... 42
By Bennett Chappel
Automatic Cutting as a Business ..... 44
The Outlook for the Steel Floor ..... 47
Fundamentals of Resistance Welding ..... 51
By Wm. E. Smith
The Status of Pressure-Vessel Welding ..... 53
By C. W. Obert
Hints for the Welder ..... 58
Editorial ..... 33
Novel Weld Made in Huge Casting ..... 50
Arc Welding Underground Steam Pipe ..... 52
All-Welded Fuel-Oil Tank ..... 55
Relies on Oxygen Gas to Make Record Flight ..... 56
Arc Welding Battered Rail Joints ..... 56
Yacht Constructed by Welding ..... 57
Welding Speed Increased by "Whip" Technique ..... 59
Redesigning a Piping System ..... 61
New Products ..... 65
New Literature ..... 67
News of the Industry ..... 68

## The Sign of the Dependable Dealer

AFTER the manufacturer of the trade marked and advertised product has once established the quality and uniformity of that product, the way of his dealer becomes continuously more easy and pleasant. The average customer has a tendency to judge the retail merchant by the quality of the goods which he carries which can be identified by means of nationally advertised trade marks. This kind of confidence is not created over night. It sometimes takes years to accumulate the kind of good will referred to above. The industry represented by the manufacturers of welding equipment and welding materials is comparatively young; but in spite of its youth, this industry has produced trade marked lines whose qualities have become fairly well established and can be readily identified by trade marks. The advertising which was done ten and even fifteen years ago is still bearing fruit because it has all helped to build up confidence among users—a confidence which makes them stay close to a source of supply of products which have won a reputation for quality. The advertised line is the line that people ask for.

Published on the 15th of Each Month by

THE WELDING ENGINEER PUBLISHING CO.
608 S. Dearborn St., Chicago, Ill.
Telephone WEBster 7134

G. H. Mackenzie ..... President and Treasurer
H. S. Card ..... Secretary

H. S. Card ..... Editor
F. L. Spangler ..... Managing Editor
C. T. Price ..... Associate Editor
A. W. Swift ..... Associate Editor

Eastern Office—222 American Circle Bldg., New York. T. E. DePew, Eastern Manager. Telephone, Columbus 6941

East Central Office—
124 Engineers Bldg., Cleveland, Ohio, R. A. McCarthy, Representative

Subscription payable in advance and postage free.
United States and possessions and Canada ..... $3 a year
Foreign Countries ..... $4 a year
Single copy, domestic ..... 25 cents
Single copy, foreign ..... 30 cents

Entered as second-class matter January 20, 1916, at the postoffice at Chicago, Illinois, under the act of March 3, 1879.

The Welding Engineer is a member of the Audit Bureau of Circulations and of the Associated Business Papers, Inc.

Last Advertising forms close at 8:00 a. m. on the 12th. To show proof for correction copy must be received at an earlier date and allowances should be made for delay to mails. All copy should be in by the 12th of the month at the latest.

The Welding Engineer does not publish in its news or advertising columns any matter that deals with or refers to either personal or legal controversies.

Authorized Representatives
CLEVELAND—R. K. Randall, 2261 E. 14th St.
DENVER—A. G. Odell, Public Opportunity School.
GREAT BRITAIN—Capt. D. Richardson, 26 Winterbrook Road, Herne Hill, London.
AUSTRALIA AND NEW ZEALAND—R. Hill, Matlock House, Davenport, Auckland, New Zealand.
SOUTH AFRICA—J. W. Arnison, 35a Victoria Ave., Benoni, Transvaal, South Africa.

# Buyers' Index

*Readers of The Welding Engineer will find this index to contain the most accurate information obtainable relating to welding apparatus and supplies. The advertising section includes the principal manufacturers of the United States.*

**ACETYLENE (Compressed in Cylinders)**
Air Reduction Sales Co.
Commercial Acetylene Supply Co.
Kansas City Oxygen Gas Co.
Modern Engineering Co.
International Oxygen Co.
Prest-O-Lite Co.

**ACETYLENE CYLINDERS**
Pressed Steel Tank Co.

**ACETYLENE WELDING WIRE**
Air Reduction Sales Co.
American Brass Co.
American Steel Engineering Co.
American Steel & Wire Co.
Atlas Foundry Co.
Central Steel & Wire Co.
Craftsweld Equipment Co.
Edgcomb Steel Co.
Fusion Welding Corporation
Hollup Corp.
Igoe Brothers
Imperal Brass Mfg. Co.
Kansas City Oxygen Gas Co.
Koro Corporation
Mueller Brass Co.
Oxweld Acetylene Co.
Page Steel & Wire Co.
Reid-Avery Co.
Roebling, John A., Sons Co.
Seneca Wire Mfg. Co.
Standard Steel & Wire Co.
St. Paul Welding & Mfg. Co.
Steel Sales Corp.
Stoody Co.
Joseph T. Ryerson & Sons, Inc.
Taylor-Wharton Iron & Steel Co.
Torchweld Equipment Co.
Wickwire Spencer Steel Co.
Weldit Acetylene Co.
Williams & Co.

**ALUMINO-THERMIC WELDING**
Metal & Thermit Corporation

**ALUMINUM SOLDER**
Crown Aluminum Solder Co.

**ANNEALING FURNACES**
General Electric Co.
Westinghouse Elec. & Mfg. Co.

**APRONS (Asbestos)**
Ideal Face Shield Co.
Olympic Glove Co.

**ASBESTOS INSULATED WIRE AND CABLE**
Central Steel & Wire Co.

**BENCHES, WELDING**
Standard Pressed Steel Co.

**BLOW PIPES**
See "Torches"

**BOOKS**
The Welding Engineer Pub. Co.
General Electric Co.
Lincoln Electric Co.
Linde Air Products Co.
Electric Arc Cutting & Welding Co.

**BRAZING OUTFITS**
Air Reduction Sales Co.
Bastian-Blessing Co.
Craftsweld Equipment Co.
General Welding and Equipment Co.
Harris Calorific Co.
Imperial Brass Mfg. Co.
International Oxygen Co.
Kansas City Oxygen Gas Co.
K-G Welding & Cutting Co.
Lotan Research Corp.
Alexander Milburn Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Sight Feed Generator Co.
Torchweld Equipment Co.
Victor Welding Equipment Co.
Williams & Co.

**BRONZE FILLER RODS**
American Brass Co.
Bridgeport Brass Co.
Central Steel & Wire Co.
Chase Brass and Copper Co., Inc.
Lotan Research Corp.
Mueller Brass Co.
Oxweld Acetylene Co.
Steel Sales Corp.

**BUFFERS**
R. G. Haskins Co.
N. A. Strand & Co.

**BUTT WELDERS**
See "Electric Resistance Welders"

**CABLE (Arc Welding)**
Allan Mfg. & Welding Co.
Central Steel & Wire Co.
Fusion Welding Corp.
Electric Arc Cutting & Welding Co.
General Electric Co.
Thomson-Gibb Welding Co.
Hollup Corp.
Lincoln Electric Co.
Quasi-Arc, Inc.
John A. Roebling Sons Co.
Joseph T. Ryerson & Sons, Inc.
Westinghouse Elec. & Mfg. Co.
Wilson Welder & Metals Co.

**CARBIDE**
Air Reduction Sales Co.
National Carbide Co.
Shawinigan Products Corp.
Union Carbide Sales Co.

**CARBON (Blocks, Paste, Electrodes, etc.)**
Air Reduction Sales Co.
Central Steel & Wire Co.
Electric Arc Cutting & Welding Co.
National Carbon Co.
Oxweld Acetylene Co.

**CARBON BURNING EQUIPMENT**
Air Reduction Sales Co.
Bastian-Blessing Co.
Craftsweld Equipment Co.
Harris Calorific Co.
Imperial Brass Mfg. Co.
International Oxygen Co.
Kansas City Oxygen Gas Co.
K-G Welding & Cutting Co.
Milburn, Alexander Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Torchweld Equipment Co.
Victor Welding Equipment Co.

**CAST IRON SOLDER**
Crown Aluminum Solder Co.

**CAUSTIC POTASH**
Innis, Speiden & Company

**CUTTING ELECTRODES (Electric Arc)**
Allan Mfg. & Welding Co.
Arcos, Inc.
Electric Arc Cutting & Welding Co.
Fusion Welding Corp.
General Electric Co.
Lincoln Electric Co.
National Carbon Co.
Westinghouse Elec. & Mfg. Co.
Wilson Welder & Metals Co.

**CYLINDERS (Acetylene)**
Pressed Steel Tank Co.

**CYLINDERS (Oxygen, Hydrogen)**
Chas. L. Gulick
Harrisburg Pipe & Pipe Bending Co.
Wm. Wharton, Jr., Co.

**DRILLS, PORTABLE ELECTRIC**
R. G. Haskins Co.
Stoody Company
N. A. Strand & Co.

**ELECTRIC ARC WELDING OUTFITS**
Allan Mfg. & Welding Co.
American Steel Engineering Co.
Burke Electric Co.
Electric Arc Cutting & Welding Co.
Electric Welding Machine Co.
Electrical Equipment Co.
Fusion Welding Corporation
General Electric Co.
Goodman Electric Machinery Co.
Thomson-Gibb Welding Co.
Hollup Corp.
Lincoln Electric Co.
Northwestern Mfg. Co.
Owen Electric Mfg. Co.
Quasi-Arc Incorporated
Joseph T. Ryerson & Sons, Inc.
Shrader Electric Co.
Stoody Co.
Waters Welders, Inc.
Westinghouse Elec. & Mfg. Co.
Williams & Co.
Wilson Welder & Metals Co.

**ELECTRIC RESISTANCE WELDERS**
American Transformer Co.
Federal Machine & Welder Co.
General Electric Co.
Gibb Welding Machines Co.
Goodman Electric Machinery Co.
Joseph T. Ryerson & Son
Taylor-Winfield Co.

**ELECTRODES (Carbon Arc Welding)**
See "Cutting Electrodes"

**ELECTRODES (Metallic Arc Welding)**
American Steel & Wire Co.
American Steel Engineering Co.
Atlas Foundry Co.
Central Steel & Wire Co.
Edgcomb Steel Co.
Electric Arc Cutting & Welding Co.
Fusion Welding Corporation
General Electric Co.
Thomson-Gibb Welding Co.
Hollup Corp.
Igoe Brothers
Koro Corporation
Lincoln Electric Co.
Maurath, Inc.
National Welding Products Corp.
Page Steel & Wire Co.
Quasi-Arc, Incorporated
Reid-Avery Co.
Roebling, John A., Sons Co.
Joseph T. Ryerson & Sons, Inc.
Seneca Wire & Mfg. Co.
Steel Sales Corp.
Standard Steel & Wire Co.
Stoody Company
Taylor-Wharton Iron & Steel Co.
Wickwire Spencer Steel Co.
Williams & Co.
Wilson Welder & Metals Co.

**ELECTRODE HOLDERS**
Allan Mfg. & Welding Co.
Burke Electric Co.
Electric Welding Machine Co.
Fibre-Metal Products Co.
Fusion Welding Corporation
General Electric Co.
Thomson-Gibb Welding Co.
Hollup Corp.
Koro Corporation
Lincoln Electric Co.
Northwestern Mfg. Co.
Owen Electric Mfg. Co.
Stoody Co.
Waters Welders, Inc.
Westinghouse Elec. & Mfg. Co.
Williams & Co.
Wilson Welder & Metals Co.

**ELECTRODE TIPS (Resistance Welding)**
Elkon, Inc.

**ELECTROLYTIC OXYGEN AND HYDROGEN GENERATING EQUIPMENT**
International Oxygen Co.

**FACE SHIELDS (Arc Welding)**
Allan Mfg. & Welding Co.
Burke Electric Co.
Central Steel & Wire Co.
Chicago Eye Shield Co.
Electric Arc Cutting & Welding Co.
Fibre-Metal Products Co.
Fusion Welding Corporation
General Electric Co.
Thomson-Gibb Welding Co.
Hollup Corporation
Ideal Face Shield Co.
Lincoln Electric Co.
Northwestern Mfg. Co.
Owen Electric Mfg. Co.
Quasi-Arc, Incorporated
Stoody Company
Joseph T. Ryerson & Sons, Inc.
Sellstrom Mfg. Co.
Westinghouse Elec. & Mfg. Co.
Waters Welders, Inc.
Williams & Co.
Wilson Welder & Metals Co.
Willson Products, Inc.

**FIREPROOF PLASTIC MATERIAL**
Air Reduction Sales Co.
National Carbon Co.

**FLANGES, WELDING**
Bonney Forge & Tool Works

**FLUE WELDERS (Electric)**
General Electric Co.
Joseph T. Ryerson & Sons, Inc.

**FLUXES**
Air Reduction Sales Co.
Anti-Borax Compound Co.
International Oxygen Co.
Kansas City Oxygen Gas Co.
Lotan Research Corp.
Metal & Thermit Corp.
Central Steel & Wire Co.
Modern Engineering Co.
Oxweld Acetylene Co.

# EDITORIAL

## School Equipment

A SALES MANAGER who has on several occasions recently worked with welding schools who are trying to solve the problem of equipment, has noticed that the school authorities have divided ideas on the matter of standardizing on particular makes. The same situation seems to prevail among the manufacturers of equipment. There are some who consider very seriously the advertising value of a school using their equipment exclusively and others who favor the idea of seeing a school equipped with several different makes. A survey of the equipment situation in a large number of schools indicates that a good many of them have standardized on a single make, but there are also a number which use quite an assortment so that students can familiarize themselves with different styles. From the students' point of view, there is something to be said on both sides. It is naturally of some advantage to him to become familiar with different styles of equipment, because if he has time to become thoroughly acquainted with several different makes, he is apt to get a better understanding of what the real fundamental things are in the construction of a welding torch. However, if there are too many kinds of equipment, and representatives of all makes get the habit of camping on the trail of students and talking to them about apparatus, his attention may easily be diverted from the main subject of his course, which is the weld itself. The sales manager who raised this question has exerted his influence in several cases to get the school to adopt two or three makes of torches which are in most common use in the neighborhood of the school. This, he says, gives them some idea of variety, and because there are not enough different ones to cause confusion, it does not interfere with their interest in the welding operations. In fact, he claims that this is the most satisfactory all around solution that he has found for the problem of the proper equipment of a welding school. There are so many different types of schools, and the factors governing the selection of equipment vary so much that it is out of the question to expect any standardization of method by all of them. It is important, however, that students of welding should be fully informed regarding the important fundamental principles of construction and operation. They should know what the safety devices are and what the safe methods of handling and operating are, and they should be taught how and why to keep the school equipment in the finest possible working condition.

## The Steel Highway

FOLLOWING the 1929 Convention of the International Acetylene Association, newspapers in a number of cities printed despatches forecasting the use of steel highways for handling the traffic of the future. The picture is by no means too visionary for thoughtful consideration. Provided the steel mills of the future have ample production capacity to supply the material on an economical basis, the big advantages of low construction costs and high salvage value will undoubtedly receive more and more attention from highway engineers in search of the best and fastest methods of construction of new roadways. Anyone who has done a considerable amount of touring has seen ample evidence that huge sums have been sacrificed in the past through methods of road building which failed to produce a serviceable highway. Over and over, special kinds of road construction which were expected to last a lifetime have crumbled away under the heavy traffic of trucks and motor buses. Discussions of the battle deck type of welded steel floor which have been circulated during the past year suggest that here may be the basis of a method of road construction which can be depended upon to not fail in service. Engineers in the welding industry who are looking for new fields to conquer or large scale welding operators where their talent can be employed to good advantage should look over this possible field of activity very carefully.

## Eliminating the Tripping Hazard

MORE lost-time accidents in industry occur through falls resulting from stumbling or tripping than from any other source. Such hazards can be eliminated only if the floors or aisles and other passageways are kept smooth and free from obstructions. As a step in the elimination of this hazard, the Laclede Gas Light Co., of St. Louis, welds the edges of floor plates so they cannot become loose. This is particularly important around moving machinery or belts, where if one trips or stumbles serious injury may result. It is far better to spend a few minutes welding the loose edge of a floor plate than to take chances on injuring a workman. Better yet, weld all the edges of floor plates, whether loose or not; then you can be assured that one more hazard has completely been done away with, and the floor will not only be safe to walk over but its smoothness will facilitate the transporting of materials.

## Now It's Welding Paper

THE current advertisement of one of the leading manufacturers of envelopes uses the phrase "glue-welded" to describe their latest development in strong envelopes. First glance at the advertisement almost suggests that this firm has found a method of welding paper and applied it to the manufacture of envelopes. Thus it becomes a strong reminder of an interesting treatise on the subject of welding in the lumber industry by the use of wooden electrodes, a treatise which is known to a few people in the welding industry. A careful reading of the advertisement, however, gives one the impression that this company wishes to compare its methods of glueing seams with the strength obtained by welding metals. It would not be surprising if other manufacturers of products made from non-metallic materials would occasionally compare the strength of their assemblies to the strength of welds. On the whole, the use of the word "welded" in connection with a paper product is an interesting proof of the acceptance of welding as a dependable method of joining. There are many conditions and activities which could be listed to show that throughout the metal working industries welding is not only accepted as a dependable process, but that plant executives are making every effort to utilize welding to its maximum possibilities. The vast majority of them have passed through the stage where they call for proof and have arrived at the stage where they just call for co-operation, in working out the best methods of application. Evidently the advertising manager of this paper product has been impressed by these facts and realizes that men in industry look upon the welded joint as the ultimate in strength. For this reason, we find a manufacturer of a product which cannot be welded making use of the term for the sake of emphasizing the strength of his product.

This 12-inch compound turn was made with two 90° TUBE-TURNS. Only 3 welds were required. . . TUBE-TURNS are lighter, stronger and safer than any other stock fittings because they are *forged from the same material as the pipe in the line.* If you are interested in better, more economical piping, you *need* the facts about TUBE-TURNS.

Lakeside Hospital, Cleveland, Ohio. . . Buerkel & Co., Inc., of Boston, Engineers. . . The W. B. Van Sickle Co., of Cleveland, Contractors.

# *What does this suggest* TO YOU?

**This photograph shows how ANY change in direction—from the simplest angle to the most difficult compound turn—can be made on the job *with TUBE-TURNS*, the stock fittings for pipe welding.**

**TUBE-TURNS are lighter and stronger than any other stock fitting available today. They cost less than any other fitting of comparable strength. They are installed with only two welds—*each straight across the pipe!***

**Short-radius. Non-porous. Uniform in wall-thickness. No buckling, thinning or flattening. Cause less pressure drop. Stocked in all sizes—in 45°, 90° and 180° types—by the distributors listed below. *Write today for full details and prices.***

*Address:* **TUBE-TURNS,** *Incorporated*
*General Offices:* **1305 Shelby St., Louisville, Ky.**

| CHICAGO | NEW YORK | PHILADELPHIA |
|---|---|---|
| *110 S. Dearborn St.* | *30 Church Street* | *Bourse Bldg.* |

# TUBE-TURNS

**DISTRIBUTORS:** *Baltimore, Md.,* The Heat and Power Corp. . . . *Cambridge, Mass.,* Baker Supply Co. . . . *Cleveland, O.,* M. S. Maleson Co. . . . *Detroit, Mich.,* C. E. Phillips and Co. . . . *Houston, Tex.,* Maintenance Engineering Corp. . . . *Los Angeles, Cal.,* Buck and Stoddard . . . *Pittsburgh, Pa.,* Herr-Harris Company . . . *St. Louis, Mo.,* H. A. Woodworth Engineering Company . . . *Toledo, Ohio,* Mason Equipment Company . . . *Tulsa, Okla.,* The Moorlane Company *Honolulu,* Hawaiian Gas Products, Ltd.

# Welding in 1929 and 1930

## Prominent Men in the Industry Look Forward to the New Year With Greater Expectancy for New Business Than Ever Before

*A SERIES of financial blowouts let a lot of folks down on the rims during the closing weeks of the last football season, but tubes have been patched and spares put in service and the going is generally more comfortable. There has been much demand for estimates of future conditions, and in particular for definite data to support the optimistic positions of financial leaders. Therefore, The Welding Engineer has asked several well-known authorities in the welding industry to contribute to this issue statements of the accomplishments of the past year and prospects for the coming year. This request found not the slightest trace of gloom in any corner of the industry. On the contrary, the following letters will prove both interesting and inspiring to all of our readers.*

* * *

*From*
F. T. LLEWELLYN
President, American Welding Society

AN OUTSTANDING development in the welding field during 1929 is the growing practice of large manufacturing companies to organize welding departments whose function is to cooperate in the proper application of welding to their specific problems of production as well as repair.

The great need is still that of familiarizing industry with the characteristics of welding, and to get designers to think in terms of the welding process employed.

Good progress is being made in the development of tests, and the use of the stethoscope promises to remove the question of practical soundness from the laboratory and place it on a parity with the rivet-inspector's hammer. More data are needed on unit resistance to impact and fatigue.

Welding technique will automatically improve with its wider use. Several major improvements are being developed which should be available during 1930.

During the year 1929 the American Welding Society issued three noteworthy pamphlets covering:

(1) Fusion Welding and Gas Cutting in Building Construction

(2) Welding Definitions and Symbols

(3) Revised Gas Welding Manual.

The first is so arranged as to permit its incorporation into existing building codes, and thus place the use of welding as applied to structural steel on a formal basis. The second goes far towards filling a standing need for uniformity in welding terminology, and means of representation on drawings, by furnishing authoritative and tried definitions and symbols. The third completes a set of four instruction manuals on the principal welding processes—Resistance, Thermit, Fusion Arc, and now Fusion Gas.

Specifications covering recommended practice in welding aircraft joints were published in December, 1928, and their usefulness became apparent throughout the year just passed.

The work of two committees is nearing a close. The one dealing with welded rail joints has published a series of progress reports on tests made during the past seven years. Its final report is expected to draw conclusions from the previous data that will place the rail-joint situation on a clearer and sounder basis.

The other committee has been, and still is, conducting tests on several thousand welded structural joints of various types and sizes. It is now commencing to digest the results, and if, as is hoped, this work can be completed during 1930, the present year will see given to the industry a statement of the unit strength of fundamental types of structural joint together with the degree of uniformity that was found in the welded output of forty structural shops located in every part of the country.

Other committees are working on various phases of the welding art, some fundamental, some applied. Of special interest is the one recently organized to prepare specifications for the qualifying tests to which welders should be subjected. Standard requirements for this purpose are much needed by the industry.

During his lifetime the late S. W. Miller offered annually a medal for the most valuable contribution to the art of fusion welding. The spirit of this award has been continued by the Society in a similar annual offer of a medal bearing Mr. Miller's name, but with scope enlarged so as to embrace any process of welding.

* * *

*From*
J. F. LINCOLN
The Lincoln Electric Company

THE outstanding development in arc welding during 1929 has been the commercial production of processes and electrodes which will produce ductile welds both by hand welding and automatically. This has been possible for a year or two past in the manufacturing laboratories, but it is only within the last twelve months that its application has become possible universally.

In general we think of an advance of this kind as being tied up with greater cost or slower operation, but in this case the welds of greater ductility, both hand and automatic, are made at higher speeds than those under the older methods. This of course opens up a number of applications which have been impossible commercially and technically heretofore. Some of those which have become commercial during the past year because of this advance in the art are the following:

The manufacture of steel water pipe.

The butt welding and lap welding of the field joints of oil and gas pipe lines.

The welding of rear axle housings for automobiles by the Electronic Tornado process.

The welding of steel barges and steel tank tops in freight-carrying vessels.

The manufacture of small and large storage tanks.

There are at the present time a number of applications which are being studied. Many of these applications can be made insofar as technique is concerned but are eliminated because of law or specifications.

As an instance of this, steam boilers can at the present time be made very much better by automatically welding sheets than is possible with riveted construction, both as regards reliability, weight and cost. Yet the laws of the various states eliminate the use of this process in spite of the fact that oil stills carrying tremendously higher pressures, tremendously higher temperatures, and subject to much greater abuse, are almost universally welded. The law prohibits the use of welded tank cars in spite of the fact that a very much better, tighter, cleaner, and more reliable tank can be made than is possible with the legal construction. The greatest possibility of the future is the education of those bodies which are now holding back such applications.

The year Nineteen Thirty is going to see the following expansions in welding:

Tremendously greater application of welded steel to the replacement of cast and riveted parts.

A slow increase in its application to buildings and bridges, this application being held back for lack of economical erection methods.

The slow application in the welding of important parts in ships.

The rapid application of welding to automobiles and to airplanes.

Arc welding is a manufacturing method with the greatest possibilities of any process which has been introduced in the present generation. Its application on the whole has been fairly rapid compared to other forward steps. As is true with most new processes, it is now in the slow introductory period—it has not really started on its rapid rise in application, which era will begin shortly.

* * *

*From*
L. E. OGDEN
Oxweld Acetylene Company

PRESENT indications are that business volume in the oxy-acetylene industry will in 1930 at least equal that of 1929. The year just closing has been by far the best in the history of our industry, and new records set up thereby far exceed the superseded ones.

It is felt, however, that with the many new major applications of the process about to be realized in commercial volume, we of the industry can confidently look forward to still higher records in the very near future.

* * *

*From*
L. F. LOUTREL
Shawinigan Products Corporation

THE year 1929 has been an extremely satisfactory year with us. I hesitate to prophesy for 1930, but we anticipate that our business will continue good and believe the same will be true of the entire welding industry.

* * *

*From*
E. D. BRANSOME
Wilson Welder & Metals Company

I AM quite sure that the subject matter of the various articles in this and other issues of The Welding Engineer can, and do, depict the progress of arc welding in the past year in a manner far abler than mine.

We are of the opinion that electric arc welding in its various branches is just on the threshold of a very broad and great future.

From our studies we believe that what has gone before is merely a starting point as to what shall follow in the comparatively near future.

The speed of growth from both the technical and intrinsic standpoint is up to each component part of the industry.

* * *

*From*
L. S. THURSTON
General Electric Company

THE application of electric arc welding to structural work continued, during 1929, to be the activity arousing greatest interest, both popular and technical. The possibility of erecting buildings by this method, thus quieting the clamor in large cities, was principally responsible for the public interest; while the other economic advantages, such as savings in weight, were further demonstrated and proved for the benefit of architects, builders, and engineers.

The number of buildings and structures erected by the use of electric arc welding materially increased during this period. The first statistics of this nature were prepared by Frank P. McKibben in July, 1928, when he listed 100 structures, consisting of bridges and buildings. In July, 1929, the total had increased to 138. The number of welded buildings alone jumped from 43 to 65, a 50 per cent increase.

A general activity in municipal and state bodies was noted throughout the year towards the adoption of ordinances and laws allowing the use of welding in building construction. Early in the year the 38 municipalities in the western and southern parts of the country had sections in their building codes covering this point, and many followed suit later. It was not long before the legislature of the State of Pennsylvania had passed a law allowing this type of construction to be used in first-class cities, municipalities below that grade being already free to adopt their own codes.

Model ordinances were framed by the American Welding Society, and these were submitted to municipalities for consideration. Pittsfield, Mass., was the first city in the country formally to adopt this new building code. In addition, Pittsfield was the first truly eastern city to incorporate welding in its code in any form.

A highly important contribution to the building art was announced by the American Institute of Steel Construction at its seventh annual convention at Biloxi, Miss., on November 14th. This was the development of a new type of arc welded steel floor which materially reduces the weight of the structure. This floor construction, known as the "battledeck" type, was demonstrated by the erection of a sample structure during the convention in the presence of the institute members. Electric welding plays an important part in the development, a special automatic arc welding machine being used to "stitch" the plates and beams together which form the flooring. The resulting structure met all specifications and tests satisfactorily.

There appears to be a field for much wider application of the arc welding process, as follows:

(1) Installation of piping, as used in the plumbing and heating requirements of large factory buildings, office buildings, hotels, and apartment houses.

(2) In the airplane industry.

(3) In the fabrication of structural steel buildings.

(4) In the fabrication of machines as a substitute for castings.

(5) In quality welding and for welding thin metals and alloys, the atomic hydrogen and the shielded-arc processes are being used to a greater extent.

In addition to the above, and as a means towards furthering a broader application of welding, there is an urgent necessity for better training and more rigid requirements of welders and also some simple and improved methods of testing welds.

* * *

*From*
F. E. WEAVER
The American Brass Co.

WE contemplate a steady and substantial growth for welding, especially bronze welding. It is our endeavor to study, foster, and meet requirements of the great number of engineers and craftsmen who have become interested in bronze welding.

We are, of course, unable to produce and offer every new alloy in a welding rod which is suggested to us by the inventive mind; nevertheless it is quite remarkable as to the variety of our alloys, each suited to a particular requirement now in constant demand and in production through our mills.

Sales of bronze welding rods have shown an increase month by month over the preceding year; and, contrary to the course followed in some staple lines, there has been no slackening in the demand for welding rod.

We receive substantial inquiries and orders from interested engineers from foreign countries far removed from the United States. The art of making a good weld appears to be doubly valuable when needed in some country where a replacing part is not as readily available as in the United States.

The writer is enclosing, for your information, copies of

recent pamphlets which indicate to you something of the variety of materials and uses of copper alloy welding rod. We are endeavoring to do a reasonable share of educational field work and we believe our efforts in this direction are appreciated by distributors and consumers.

* * *

*From*

G. N. SIEGER
Elkon, Inc.

PRODUCTION engineers, especially in the automotive industry, are appreciating more and more the value of welding in their parts fabrication. One of the limits in the older types of resistance welding was the necessity for single welds in the case of spot welding, and deformation when conventional butt welding was employed.

Recently, by the employment of an electrode die material withstanding greater pressures, but not at the expense of conductivity, projection welding made possible the multiplicity of spots at one time, on the one hand; and flash welding, the superior mode of butt welding, has come to the fore.

So outstanding have these two modifications been that the year 1930 will see a very large number of new projection welders and flash welders employed in industry at the expense of spot welders and butt welders.

That the merits of welding—more especially resistance welding,—are being appreciated and employed, can best be cited by an interview recently rendered by Henry Ford, in which he said:

"* * * Great things are at hand and these are revolutionary. * * * But with electric welding we strike out into a new field. * * * The ability to combine parts by welding means the introduction of a whole new technique in metal manufacturing. We have just started. * * * The casting and the rivet are doomed."

* * *

*From*

W. W. REDDIE
Westinghouse Electric & Manufacturing Co.

THERE has been such a wealth of detail published in the technical press during 1929 on outstanding pioneer efforts, that many of your interested readers will have these fully in mind. We are glad to comment, however, on some fundamental conditions, as we see them, which have been responsible for the rapid growth during 1929, which we feel will continue through 1930.

In the progress of arc welding practice, both in application and manufacture of equipment, the tendency is always present, just as in other lines of activity, to judge progress by the spectacular achievement rather than the steady growth. The rate of permanent growth is the real measure of utility, and if the process is sound and its economy established, this rate will be proportional to the rate at which detail is developed, standards of design and execution setup, equipment installed and inspection and operating personnel trained. Again if the process is sound, safe and economical, the confidence and increased knowledge resulting from the permanent growth leads to further pioneering efforts, so that the pioneer job of last year becomes the "taken for granted" procedure of the present.

This cycle broadly typifies arc welding operations in 1928, 1929 and what we expect in 1930, and this applies to the several fields in which electric arc welding is of such great economic importance.

These fields include steel construction in buildings and bridges, new and reconstruction work, pipe line work, both field work as found in oil and gas lines, and interior construction of steam lines, fabricating activities as typified in tank and pipe work done in the shop, shipbuilding activities, machinery manufacture and maintenance work.

The permanent growth following any given pioneer effort in these fields has been rapid, no doubt due to the acceptance accorded the process on the basis of merit and economy alone, the vision with which engineers have grasped the possibilities of the process, the energy and ability with which contracting and manufacturing organizations have responded to the changes in methods required to erect a welded structure or produce a welded product and the care given to the training of inspection and operating personnel.

The tendency now in many organizations is to ask the question, "why not weld it?" rather than "why and how to weld it."

An outstanding example of this cycle of progress may be found in some of the arc welded buildings erected for the Westinghouse Electric & Manufacturing Company. Some four years ago an eleven-story building was erected for this company at East Pittsburgh, the steel for which was riveted. Soon after that time, outstanding pioneer jobs of welded steel construction in building work were carried through. Permanent growth followed these pioneer jobs and progress steadily continued through 1928 and 1929. Late in 1929 it became necessary to erect a double hatchway elevator tower at one end of the building referred to above. This tower ran the full eleven stories of the building with pent house roof on top reaching a total height of 185 feet and using some 90 tons of steel. The erectors developed a method of tier construction and erected the structure without the use of bolts. President F. A. Merrick, of the Westinghouse company, recently announced the erection of a new Engineering Laboratories Building which will be adjacent to the eleven-story building referred to of the same height and with, but slightly shorter. This will be welded. On a group of buildings completed in 1929 near Trafford City, Pa., comprising some 800 tons of steel almost all of which was erected in the field, the steel erectors, Minnotte Brothers, of Pittsburgh, Pa., report that some 27,000 pieces of steel were shipped to the job, properly assembled in the field, and welded without confusion and with confidence throughout down to the welder iron workers on the job, that the job would be a success, which it was. These and similar examples, which have been recounted in the technical press in detail during the year illustrate the cycle and rate of growth and expansion of welding activities, and leave the definite impression that permanent growth is assured, will be rapid, and in our opinion will continue at about the same rate in 1930 as in 1929.

In the machinery construction field we find a similar situation although this is perhaps not so much under the public eye, and therefor of less spectacular appeal. Machinery manufacturers who started in 1928 have gone forward in 1929 and others will follow this lead in 1930. This progress applies to practically all classes of industrial machinery. More definite lines or zones of economy for castings and welded steel parts have begun to roughly take form and in fact some examples of machinery structures using a combination of cast and welded parts were produced during the year.

We find similar progress in the other important fields of welding, but always evidence of the same energy and ability to carry through and work out the practical problems of execution of welded designs, New problems in engineering and execution of designs are of course brought out but this is only a further indication of the permanent growth of welding as these will be solved in their turn.

In the equipment field, development is keeping pace with the expansion in application. Additional ratings of motor-generators have been added as needed.

Automatic welding is coming more into general use. A new automatic welder was placed on the market in 1929 by the Westinghouse Company which it is thought will sub-

stantially contribute to the more rapid development of automatic welding operations in that the electrode is automatically fed at the right rate as determined by the fusion of the electrode. This automatic variation of feed is not only sufficient to take care of the ordinary changes in the arc circuit due to the welding, but will take care of relatively wide changes of current adjustment due to changing the welding procedure or change in size of electrode which also necessitates changes in welding current being used.

A review of the reasons for the growth of welding during 1929 with which your readers are familiar leads us to believe that this rate of progress will continue in 1930 and that machinery developments will readily keep abreast of requirements both in manual and automatic welding.

* * *

*From*

W. F. STOODY
Stoody Company

WE think you are entirely right in assuming that 1930 will be a good year for welding.

Certainly the results we obtained in 1929 by spreading the gospel of hard facing were very gratifying; and taking these satisfactory results as a basis in anticipating the requirements of the industry for 1930, we have just increased our entire production facilities 50 per cent.

You may rest assured that our plans for 1930 are in keeping with the fastest growing industry in the United States; and knowing the hard-facing industry to be based upon the soundest foundation, namely, adaptability and economy, we expect to continue as heretofore to back up our convictions with our entire time, interest and resources.

I am glad of this opportunity to state my company's attitude and to assure you that new developments in welding in 1930 will add their impetus to what a few years ago we used to allude to as an infant industry, but what is now considered an essential and necessary part of every manufacturing process from the time raw material leaves the ground until it is used and worn out by the customer and then is reclaimed by welding.

My most earnest wish for you and every one of your readers is that your reward be in keeping with the efforts you put forth in 1930.

* * *

*From*

M. L. ECKMAN
The Taylor-Winfield Corporation

AS to the welding outlook for 1930 and a review of the year just closing, I would say that no exaggeration need be employed whatsoever in emphasizing the fact that there is no industry in the industrial world today that has such a bright future ahead of it or in which greater progress has been made than in the past year in the electrical resistance welding field.

I should like to point to a pertinent fact here to be seriously considered by all those contemplating the use of electrical resistance welding or those considering welding from any commercial standpoint.

Welding is a method of assembly. Further, welding is the world's best method of assembling units into one composite article. The chief factors that recommend it are quality, speed and low cost—the three prime factors to be considered in the management of any business.

Welding, being the world's best assembly method, has become the leader in that method of manufacture known as mass production. This is proved by the fact that the automobile industry of the world spent millions and millions of dollars in the last few years in equipping their plants to assembly by the welding method. Listed among these manufacturers are the Packard Motor Car Company, Hudson Motor Car Company, Chrysler Motor Car Company, Studebaker Motor Car Company, Hupmobile Motor Car Company, Ford Motor Company, Murray Body, Briggs Body, and many other automotive manufacturers.

The automotive industry of the world surpassed all kinds of manufacture in the value of the product turned out in 1929, its total production for 1929 being valued at $4,631,000,000, and it turned out a better product per dollar value received, and also made more money for its stockholders than any other industry in existence. These facts can be laid in no small measure to the part which electrical resistance welding played in the manufacture of this necessity of modern life, the automotive vehicle.

I have noted the trend of all manufacturers whose product is made of metal to follow in the foot steps of the automotive industry and adapt their products so they can be assembled by welding. A recent survey which the writer made of the industries now using welding or getting ready to profit by the use of welding in the manufacture of their output reads like a detailed list of the manufacturing concerns of the world.

Electrical resistance welding is branching out in its scope. For instance, in the last year a great deal of experimenting has been carried on with the welding of brass and copper, aluminum, and the non-ferreous metals. A great deal of experimental work has been done on the alloyed steels. Stainless steels are welded by this method with no trouble whatever. Much aluminum, brass, and copper are being welded by the resistance method.

I note that the rivalry between exponents of the different branches of welding is fast disappearing. For instance, the man who knew arc welding thoroughly and was not so well acquainted with resistance welding would have nothing to do with resistance welding and would stick to his arc welding, claiming that was the only right and proper way. The man acquainted with resistance welding and not so well acquainted with arc welding was likewise on the other side of the fence. But we now find that welding engineers are using all methods successfully and find that instead of being competitors of each other that they are really assistants one to the other. Where more arc welding is used, more resistance welding will be used. Where resistance welding is well and favorably known, arc welding can be introduced with little trouble. Each particular class of welding falls into its respective field and each assists the other.

The electrical resistance manufacturer is beginning to standardize his article and get it down to a production basis. Data are being collected, tabulated and correlated in such a manner that they become useful information for those who wish to utilize welding in their businesses.

Every mechanical or technical magazine or publication which you pick up usually has one or more articles dealing with welding and its application, usefulness, and general utility. New York City has appointed a commission to draw up a code for welding for use in the building of structural steel work inside the city limits. Many other cities are working on the same problem.

Altogether, the year 1930 should prove to be just another step forward for all welding processes.

Large industries are spending and planning to spend enormous sums for welding machinery during the coming year. One large concern has built a 100-ton welding machine. Welding machinery is being built now with a thought of universal application to the product in mind so that, should the article be changed somewhat to conform to new designs, the welding equipment remains adaptable to the damaged product.

I trust that some real benefit may be gathered from these few remarks with regard to the future of welding and a survey of the closing year. The closing year has been the

best year that electrical resistance welding machine manufacturers have ever experienced. The next year promises to be double.

* * *

*From*

A. A. HELLER
International Oxygen Company

THE first oxygen plant in Russia was erected in 1911. In the next three years and during the first years of the War, several more oxygen and acetylene plants were built, as well as two small carbide plants—one in St. Petersburg and one in the Don Basin. Welding equipment was manufactured on a small scale in Russia, but most of it was imported from France and Germany, as were oxygen and acetylene cylinders. Some electric welding was attempted at the same time; in fact, the Russian engineers, Bernados and Sliavanoff, were among the first to experiment with electric welding, and were considered the fathers of the art.

In the years prior to the war the welding industry made some progress; but the war, and later the Revolution and civil war, disorganized it completely. The small number of gas and welding engineers, foreign and native, drifted far and wide, the plants were not looked after, welders found other occupations, and the industry practically disappeared. Slight attempts were made to re-establish the compressed-gas plants and welding with the beginning of the reconstruction period in 1921; but it was only some years later, with the organization of the Russian American Compressed Gas Company in 1926, that the industry took on new life and began to develop.

"Ragas," as the Russian American Compressed Gas Co. is known for short, built its first plants in Moscow—oxygen (Heylandt) capacity 100 cu. meters per hour, and acetylene (L'Air Liquide) 20 cu. meters per hour capacity, and imported a considerable quantity of cylinders and equipment. The arousing of sufficient interest in welding, the creation of a market for its products, was a task of some difficulty at the beginning. The company had to teach welders and to see that there were enough carbide and other materials in the country, before it could dispose of its oxygen. In connection with its gas plants, the company established a barrel plant, a school for welders, and took on welding and cutting work in order to spread the uses of oxygen and acetylene and to arouse interest in the art. In the next year or two, Ragas established additional oxygen and acetylene plants in Rostov and Swerdlovsk, proceeded to build a plant for the production of welding equipment, and extended its operations manifold. In 1928 and 1929 the company carried out two important pieces of work—the welding of oil pipe lines in the Grosny-Tuapse and Baku-Batum oil fields, the latter for a distance of some 650 miles; 10 and 12 in. pipe was used, the welding being done under the most difficult topographical and weather conditions and successfully completed in the fall of 1929.

The interest in welding in the meantime was becoming general, and the demand for oxygen and acetylene increased by leaps and bounds, until today the capacity of Ragas, and of the other plants operating in U.S.S.R., is insufficient to cover the requirements.

The development of the welding industry corresponds to the general industrial development of the Soviet Union. The so-called Five-Year Plan provides for the increase of Russian industry by nearly 200 per cent during the five years beginning October 1, 1928. But the first year of the period exceeded expectations, and gave an increase of 24 per cent in place of the 21 per cent anticipated; and there is talk now of reducing the total period to four years and by greater effort to obtain the five-year results in the shorter time.

Stress is being laid chiefly on the development of heavy industry, the production of metals and metal products and chemicals. The welding industry must therefore assume increased importance. It is called upon to become a decided factor in this tremendous industrial upbuilding, as it concerns every part of the program; whether it is the construction of a power plant, the building of a factory, pipe laying, railroad construction or repair, or mass production of articles of metal—welding of one type or another must be used in every case.

Side by side with this industrial upbuilding, the five-year plan pays great attention to the reorganization of farming in the Soviet Union. The new modern machine-operated gigantic farms will employ tractors and mechanical equipment, artificial irrigation, and fertilizers. The tractors stations will require oxy-acetylene welding for the upkeep and repair of the equipment.

In line with all this industrial and machine-farming development, "Ragas" is planning to extend greatly its facilities and operations. Its program for the coming year provides for the erection of nine new plants—four oxygen plants, four acetylene, and one large plant for the production of welding equipment and supplies. Provision is also made for the increase of the existing plants, both in capacity and scope of operations. The enlargement of the existing carbide plants is contemplated, as well as the erection of one or two new ones in the near future. By the end of the five-year period it is hoped to bring up the production of carbide to 50,000 tons, of oxygen to 700,000,000 cu. ft., and the production of apparatus, materials and supplies in corresponding volume.

Electric welding is also finding considerable application, and its field is constantly widening. The recent agreement with the General Electric Company will further the construction and spread of welding machines. This agreement does not exclude other types from being introduced into the country; there is plenty of room for growth.

One of the most serious questions in connection with the welding industry is the lack of technicians and skilled welders. There exist several welding schools in U. S. S. R., and their number will be increased materially the coming year. Recently a welding "Technicum" — Technological High-School — was established in Moscow, to train foremen and junior engineers for the welding industry. This, of course, is far from being enough to provide the country with all the necessary skill. Very likely foreign engineers and welders, and possibly Americans most of all, will have to be invited to help in the development of the art and the training of the men required.

American methods and experience are greatly prized in U. S. S. R. and American representatives welcomed. In fact, in all branches of industry, American achievement is the ideal to which the Soviet Union strives. Russians are a capable people, eager to learn, and desire to learn from the best teachers. There are great opportunities for Americans, unafraid to pioneer and to help in the development of a great country, whether as active participators or as specialists, consultants and instructors. The progress of "Ragas" in the three years time of its existence may be taken as an indication of the possibilities that exist in the situation.

* * *

*From*

CAPT. D. RICHARDSON
London England

THE past year has not been marked by any conspicuous development. In spite of the continued depression in the engineering industries—the outlook is still anxious—it is gratifying to note the marked progress of the oxy-acetylene and electric arc processes. The leading firms exploiting these processes are able to record a considerable improvement in sales over the previous year. The intensive propaganda, particularly of the leading oxygen and dissolved acetylene manufacturers, and the enterprising educational demonstration and "after purchase" service given by these firms must, in the prevailing conditions, be largely responsible for such improvement.

There is no doubt that the marked recovery which has commenced in electrical engineering and the smaller relative improvement in shipbuilding, marine engineering and motor vehicles will, in the coming year, be reflected in a considerable expansion in the application of welding processes. There are

indications that electric resistance welding processes are destined to find increased application in the coming year as a result of intensive propaganda. Up to the present the large majority of the technical articles dealing with welding are restricted to the oxy-acetylene and arc welding processes.

The closer co-operation between the British Acetylene and Welding Association (now the British Acetylene Association) and the Institution of Welding Engineers has led to the Association confining its activities to matters relating to acetylene and its membership to firms manufacturing or selling acetylene, etc., or having a bona-fide interest in the acetylene industry, and the Institution to promoting the extension of the use of welding and the advancement of the science of welding in all its forms.

Since its formation in 1924 the Institution of Welding Engineers, which by the way is the only Institution in Great Britain dealing with welding in all its phases, has, in spite of its value, or potential value, to the welding industry apparently failed to attract the obviously large number of persons interested, directly or indirectly, in welding. The number of members at the end of the first year was 139, whilst at the date of the last report, March 31, 1929, it had only reached 143. It is hoped that the forward policy adopted in October last in issuing a quarterly Journal called "Welding News" will stimulate further interest in welding processes and lead to a considerable increase in membership. It is of interest to note that the whole of the articles contained in the first issue were abstracted from American Journals, including The Welding Engineer.

The technical press are giving increased attention to welding, and in some cases are devoting sections to the welding industry. It is again interesting to note their indebtedness to the extensive research and other work now being carried out in America. As regards research, although this country has nothing to correspond to the American Welding Society, all the large manufacturing companies of both oxygen and dissolved acetylene and arc welding equipment have their own research laboratories where problems are solved to the mutual advantage of their customers and themselves. The outstanding feature of the year as far as publication is concerned was the Technical Report of British Engine Boiler and Electrical Insurance Company, Ltd., on the Fusion Welding of Pressure Vessels. The depressing conclusion of this report, based on exhaustive tests of sample welds, on the welding industry has been very marked, since nearly every technical journal gave abstracts and the conclusion which included the statement "the ordinary commercial weld falls far short of the ideal while many welds are definitely bad." There is no doubt that for this class of work "procedure control" is lacking and a perusal of articles such as "Welded Pressure Vessels" by A. O. Miller, "Oxwelding Pressure Vessels," etc., as de cribed in your Journals, would have a stimulating effect on the welding industry. It is significant that the report lacks the fundamental information as to how the welds were made and what qualifications the welders possessed to do such important work. When one reads in such an important report that "the strength of the first specimen was reduced owing to slag inclusions. . . . . The surface of the fracture in general showed poor penetration. . . . . One side of the V was defective over a large portion of the plate. . . . . The quality of the deposited metal was considerably inferior to what it should have been," etc., etc., it would suggest that much energy has been wasted in examining welds made by untrained welders.

With regard to oxygen and dissolved acetylene, probably the most important features of the year were the publication of the final reports of the Government Gas Cylinders Research Committee; the entrance of British Industrial Gas, Ltd., into the field of manufacture; the opening of new and large works for the manufacture of dissolved acetylene, etc., by Allen-Liversidge, Ltd., together with new showrooms and additional compressing stations, the construction of new and the re-conditioning of old plants by the British Oxygen Co., Ltd., together with trials on the transportation of oxygen in the liquid state. There is no doubt that when the long desired improvement in the industrial outlook takes place the firms exploiting the oxy-acetylene welding process will be in a position to take full advantage of it.

With regard to the Gas Cylinders Research Committees' Reports,—a committee which was appointed as far back as 1918 to re-examine the whole question of cylinders for transport and storage of compressed gases, other than acetylene—four reports have been issued, together with a revised summary of the first report which was originally published in 1921. These reports are chiefly of academic interest although the Government will consider matters affecting the regulation of the industry in the interests of the public. Such regulations will be welcomed by firms like the British Oxygen Co., Ltd., who have been responsible for the development of the oxygen and cylinder gas industry, their only regret being that so much valuable time has been lost during which it might already have been established on a thoroughly sound and stable basis.

The Government has established what is termed "The Home Office Industrial Museum" and with a view to preventing accidents in the welding industry are devoting a section to welding. This is in course of formation and the underlying idea is to exhibit apparatus which is known to be of good design from the safety point of view, and defective or badly designed apparatus.

Representatives of this country on the Commission Permanente Internationale, which has an extensive program of matters connected, directly or indirectly, with welding, should lead as a result of the exchange of information and co-ordinated research, to increased application of welding processes in all the countries concerned.

The training of welders is handicapped by the lack of co-ordination and the absence of any definite scheme for qualifying tests or methods of selection. It is important to note that classes for instruction in arc welding are now available and a course of six lectures on "The Principles and Practice of Arc Welding" have just been concluded at an Institution controlled by the London County Council. This marks a new development, the fee for the course being less than one dollar. The Army Vocational Training Centre, which offers an opportunity of specialized training for the serving soldier to enable him to take his place in cure life in a more improved position than that occupied by him on enlistment, has included oxy-acetylene welding in its curriculum.

In arc welding considerable progress is being made as a result of propaganda work by pioneer companies such as Alloy Welding Processes, Ltd., Quasi-Arc, Ltd., etc. The former are now publishing a bi-monthly Journal called "The Welder," which contains descriptive articles of general interest to arc welders and firms who are users or prospective users of the process.

Long and descriptive articles on welding applied to specialized industries such as the aeroplane, motorcycle, etc., and which have appeared in "Industrial Gases," have been instrumental in directing attention to the merits of welding in production work, a branch of welding which is not as fully exploited in this country as it deserves to be.

The statistics for carbide of calcium for the first eleven months of 1929 show a gratifying increase over those of 1928, and although carbide consumption is not a reliable indication of welding developments, when taken into conjunction with oxygen consumption which, although statistics are not available, is certainly well above the previous year's figures, is an indication that the oxy-acetylene proces s is not only holding its own, but is making progress.

The absence of litigation in the past year and the hopeful outlook for the welding industry during the coming year as evidenced by the preparations made and being made by the leading firms in the industry, and the improvements in apparatus as revealed at the Shipping Engineering and Machinery Exhibition held in September last, augurs well for a more prosperous and successful new year.

## THE GENERAL OUTLOOK*

Modernization will be the key word of the business year ahead. Campaigns to eliminate the obsolete in the factories, offices and mercantile establishments of the land will take the form of a veritable war on red ink. Outworn methods of management, production and sales must go.

The facts are that in spite of the recession of business during the last two months the year 1929 has been one of the largest in volume and profits of any year since the war. Many industries and trades report better margins due to reduction in unit costs, stabilization of prices, improvement in marketing methods, introduction of labor-saving machinery, elimination of overhead expense through consolidations and mergers, and general improvement in cost accounting and scientific sales methods.

The editors of the National Conference of Business Paper Editors and The Associated Business Papers expect that the three cardinal points brought forward by President Hoover's conferences on business will be put into action. The points—namely, immediate fulfillment of construction programs in major utility fields, the maintaining of wage rates and the modernizing of plant equipment and business methods,—will set the stage for a volume of business in 1930 at least equal to that in 1929.

### Profitless Prosperity Disappears

Analysis of reports in several fields, including iron and steel, machine tools, construction and building, electrical equipment, furniture, wearing apparel and automobiles, indicates that the so-called era of profitless prosperity was overcome during 1929 and the reports indicate that with money available for investment in capital improvements that will reduce costs and with an increasing volume of commercial research to improve sales methods, more business men will improve profit margins by the application of principles dramatized by President Hoover's conferences.

Those fields which have shown the greatest improvement are those in which management has definitely undertaken to reduce unit costs, without reducing wages, by improvement in plant facilities and technique or in merchandising methods. These practical lessons in better business may be expected to be carried out even more widely in the year 1930. It is evident that the gains that can be made by the shaking out of the wastes due to obsolete machinery, poor credit relations, high cost selling, and other wasteful practices, will more than offset any reduction in the volume of purchasing.

Some editors still report their industries with over-capacity, but in the same reports they indicate management willing to scrap obsolete plants and equipment with the view to matching capacity with demand on a lower unit cost basis. The textile industry is an outstanding example of this new thinking.

### Building Activities to Be Speeded

Commenting on all types of construction, the editors whose papers are concerned report that 1930 will see a greater volume of building and construction than during the last two years. They state that, nationally, this volume has been declining since May, 1928, and that the causes have been high money rates and a downward bond market. At the same time building costs have stayed stationary since 1923. With the money rate returned to 4½ per cent and the bond market on an upward trend since before the stock market crash of last fall, the editors are optimistic as to 1930 as a building year and estimate the total volume will be in excess of $8,000,000,000.

This does not include the money that will be spent on building programs by the major public utilities of the country or for federal, state or municipal public works programs which are now being formulated and put into action as the direct result of the Hoover business conferences. The railroads alone are credited with a $1,000,000,000 improvement program for 1930 and the electric light and power companies of the country will expend $865,000,000 during the year for new plant and equipment, while the electric street railways will carry through a $140,000,000 new plant program.

### Obsolete Plants and Machinery Doomed

In industrial fields the editors report that the bulk of industrial construction work will be along lines of modernizing existing plants and replacing obsolete structures and equipment. In the automobile tire field $15,000,000 will be spent for plant expansion and new equipment by manufacturers. In the iron and steel fields, 1930 will see $500,000,000 spent for expansion of which about one-third will go for plant improvements. In the meat packing industry it is anticipated that expansion during 1930 will be restricted to the vegetable oil and inedible by-product division. One concern has already instituted, in this branch, a building program that will increase its number of employes by some 3,000 men and women.

Among the industries where the editors particularly expect that replacement of obsolete machinery and equipment will play an important part during the coming year are textile, building, industrial power plants, cement, furniture, plumbing and heating fixtures, fuel oil burners motor bus lines, baking companies, hotels and commercial laundries.

In the textile field, modernization work is planned both as an immediate stimulant to general prosperity and as foundation work for more effectively meeting competition. In furniture manufacturing, 1930 will see approximately $5,000,000 spent on plant improvement. In the cement and allied fields, plant construction for 1929 was below 1928. The year 1930 will see reconstruction work undertaken to reduce costs, as this industry already has over-capacity. The same condition prevails among manufacturers of plumbing and heating equipment and this industry is actively endeavoring to get on to a profit basis. In the hotel field, the coming year will be one in which renovation and remodeling on existing structures will be the outstanding characteristic.

### Employment Outlet Considered Favorable

In the matter of wages and employment the editors consider that 1929 was a good year and the prospects for 1930 are "good or better." There were a number of cases where a slight rise in wages for the past year was reported and only three industries where the wage trend was even slightly downward. The balance reported that wages remained approximately unchanged throughout the year. In employment, the consensus was that 1929 had not been marked either by abnormal shut-downs or unusual activity and that both present employment and wage levels will continue during the next twelve months.

The introduction of automatic machinery as a means of reducing costs and increasing production has not increased unemployment. The editors report that the workers so displaced have been reabsorbed, generally by the same industry, and kept employed in other branches largely by work made possible by increased production. This is particularly true of automobile manufacturing where also the average employment throughout 1929 was higher than during the previous year and the wage trend was more markedly upward than a year ago.

### The Coming Year

The year 1930 will prove the worth of President Hoover's business conferences. Those already held have largely written off the psychological effects of the stock market collapse. Recessions in some lines due to over-production will be compensated for by the heavy construction, maintenance and modernization programs already agreed to by great groups of business. Thus, in general, the members of the National Conference of Business Paper Editors consider that the coming year already shows evidence of normal business levels.

---

*Abstracted from "War on Red Ink," by Frederick M. Feiker, Managing Director, The Associated Business Papers, Inc.*

# Trend Toward Welded Constructions

## Steel Highways, Sidewalks, Furniture, Residences Will Some Day Be Fashioned by the Hand of the Welder

By Bennett Chappel†

"ALICE in Wonderland" has nothing on "Johnny in Weldville!" Marvelous as are the radio and the aeroplane which have come out of the ingenuity of man to serve a world already traveling at a speed that defies the imagination, I am persuaded that welding and its infinite possibilities today transcend every other form of human accomplishment.

I remember the old village blacksmith where, as a boy, I stood fascinated by the glow of the forge as the village smithy heated the material out of which he made the horse shoes, swiftly fashioning its curve around the pointed end of the triangle and then deftly welding in the calks that served as toe and heel.

If anybody had told that genial "Knight of the Forge" that within his own generation there would come a time when iron sheets could be joined together with the rapidity of a sewing machine, with a seam that would defy anything but the closest scrutiny of the microscope, he would have considered such a possibility as the wildest dream of the imagination.

It is not my purpose here today to deal with the subject of welding from its technical side. I am but a layman who is ready to receive the genius of your profession as nonchalantly as I today casually listen to the radio or fly among the fleecy clouds. The world first gasps with wonder at startling developments, then accepts them calmly as a matter of course without giving a thought to the years of laborious, painstaking research work that marks the background of every such spectacular climax, every such revolutionary achievement in our modern civilization.

I read about the application of welding, not only in products made of sheet metal, of which, perhaps, the automobile is the most outstanding, but also of the buildings and bridges that are now invading the field of riveted structures of a past generation.

I am reminded that it was my privilege to talk with Mr. John Dawson of the firm of Dawson and Archer, who built the first skyscraper steel frame in New York City. It was the old Tower Building at 25 Broadway, a small building of but eight stories, and yet the frontage was so narrow that to have built its walls of masonry they would have consumed the entire available ground space.

In order to meet this condition, a far-seeing architect planned a building of structural iron with the now familiar veneer facing of stone. Mr. Dawson later built the Park Row building and other giant structures, reaching the colossal height of thirty-two stories at that time. But he told me that he got the job of building that first steel skyscraper on Broadway in New York City because none of the other builders were willing to stake their reputation or risk their money on such construction. With the typical Scotch burr in his voice, he said: "We took the job because we had just started in business and had nothing to lose, either in reputation or money."

And that was the story of the first structural skyscraper in New York City. It is a matter of historical record that two injunctions were gotten out to stop the building of this structure, by people who looked upon the skeleton framework and feared it would fall over.

Within the short span of my lifetime I have seen the skyscrapers in the cities shoot their spires to unlimited heights and I never look upon a tall building without recalling the twinkle in John Dawson's eyes as he told me the reasons why he came to land their first job.

Soon we will be able to look back with charitable mien upon just such ludicrous objections in the growth and development of the welding industry. Every one of you will draw upon the experiences you have lived through and are living through today, to frame the stories that will begin: "I remember the time when . . ." and the public will be aghast at your recital, for it will be just as hard to visualize a world then without welding as it would be to visualize a world today without skyscrapers.

I come to you to pay a tribute to the pioneers of welding. The industry is not so old but that I can have the pleasure of handing a rose to the living instead of the dead. I care not what the epitaph may be upon your tombstones. I declare now that the world owes to the welding industry a liberation of metals in the use of man that knows no limits within the flight of the imagination.

I see aerial roadways carrying transportation across the canyoned streets of our cities, welded as one continuous strip without a flaw.

I can see concrete highways on solid welded metal bases to carry the heavy traffic, and the automobiles, like the limited trains, running on tracks of steel stretching from coast to coast. The concrete highway of today is no more of an innovation than will be the welded steel highway of tomorrow.

I see the family of tomorrow living in a one piece welded house, lightning-proof, fireproof, verminproof, and insulated against heat and cold.

I see the dread toll of fire and flame fading away in the brilliant light of the welder's torch.

I see interiors of homes made beautiful by steel artcraft with its welded mantels, furniture and panel decorations.

I see bathrooms complete with their furnishings, welded and enameled throughout and shipped like automobile bodies to be dropped into the homes, complete in every detail with nothing to do but connect the faucets.

I see welded heating, cooling and ventilating units, measuring and controlling the air we breathe in office buildings and homes, all under thermostatic control.

I can see, standing out like giant arteries, great systems of welded pipe lines that carry oil, gas and water from ever-increasing distances to the great centers of population.

I can see towering smoke stacks of industry that silhouette themselves against the skyline like the pipes of a mighty organ whose diapason is heard around the world.

I can see the floors of our giant office buildings welded as units; in fact, such floors are already being installed. I can see the floors of factory buildings stretching out in welded units, whose clean polished surfaces make possible the easy handling of hand trucks in the processes of manufacture.

I can see sidewalk, curb and gutter laid in one piece on the busy thoroughfares of our cities, fashioned at the same time to carry the conduits of the city, with even the lamp posts and street signs welded in place.

I can see giant welded one piece stadiums, holding hundreds of thousands of football fans.

I can see the commerce of the world plowing the waves in welded ships whose lighter and stronger construction makes for greater safety, higher speed and lower operating and maintenance expense.

---

**Keynote address delivered at International Acetylene Assn. Convention, Chicago, November 13, 1929.*

*†Vice-President, The American Rolling Mill Co., Middletown, Ohio.*

I can see great factories and warehouses designed throughout in units of welded steel that can be shifted and moved about or added to as occasion may demand.

I can see the great agricultural industry buying sectional buildings and welding them in place.

I can see a new type of mechanic, born of the necessity of the hour, who will replace the man with the hammer and saw. With his welding tools he will cut and fashion the myriad buildings of our community like the building carpenters of our present day.

In our factories I can see the automatic welding machines fashioning the raiment of steel and iron like giant tailors, changing their products with every season to meet the style and comfort demands of a swiftly moving world.

As I project the vision of possibilities of welding and its influence upon our civilization, I am reminded that the progress of the welding industry today has been due to its own efforts rather than to the efforts of allied industries. When I say this, I am not forgetting the electrical industry and the acetylene gas industry which have ever played their part in welding progress.

On the horizon I see a fourth member to join our group. It is the great iron and steel industry coming to join your ranks so that welding may move forward foursquare, like the phalanxes of old, into new markets and new opportunities. It could be only a matter of time until the great iron and steel industry, that produces the materials for welding, would recognize its obligation to this child of the new day and new generation. You and I know and the world knows, that the iron and steel industry, and I am ashamed to acknowledge it, has been asleep to the infinite possibilities of welding. Except in a few instances, little attention has been given to the perfection of material that makes uniform welding simple and dependable. Until today it has been much like the electrical industry in those early days when it was struggling for a place in the sun and was crying out for special materials that would enable them to bring their electrical apparatus to the highest state of perfection. Here and there a concern with vision heard the cry and applied their research engineers to the problem of the electrical engineers, with the result that the electrical industry found it possible to write a new chapter in the history of power engineering.

So, too, in the welding industry. Here and there the steel industry has linked itself arm and arm with you in an attempt to give you better materials in the great evolution which you are directing. They have set their engineers to the task of developing special sheets and plates that would assure constant improvement in your field of endeavor. They have spent hundreds of thousands of dollars to fight with you in bringing welding perfection to the world. Today the iron and steel industry, as a whole, is arousing itself from its lethargic slumber, stirring itself to a recognition that in the lap of welding lies the prosperity of the iron and steel business.

I cannot answer for the other iron and steel companies as to their vision of the future of welding, but speaking for my own company, I have only to point back over a period of twenty years that we have been shoulder to shoulder with the welding industry of America, recognizing with you the tremendous possibilities that lie ahead of all of us. I have the firm conviction that the welding industry from now on will be courted where formerly it was seriously slighted, if not merely endured by the great steel industry of the world. You have come out of the swaddling clothes of childhood and stand radiant with the glow of youth and accomplishment. Nor can you rest on your laurels or lessen your effort. What the welding business needs today is a rebirth of enthusiasm; enthusiasm that kindles energy and irresistible force; that will compel the attention of the world to the tremendous economic importance of the service you have to offer.

Shoulder to shoulder the iron and steel industry and the welding industry must march onward into the sunrise of a new day where the future, revealed with all its infinite possibilities, beckons to us.

Across the sky is emblazoned this word that challenges the imagination of every man, woman and child—the FUTURE.

The letter "F" signifying FORWARD.

The letter "U" stands for UNITED ACTION.

The letter "T" stands for TENACITY and the WILL TO DO.

The letter "U" brings the strength of UNDERSTANDING.

The letter "R" reveals the REALIZATION of the GOAL to be attained.

And the letter "E," the last letter in this brilliant constellation of the new day, stands for ENTHUSIASM, that God-given force of the human soul that knows no defeat.

Let us salute the dawn of welding with the fire of determination in our soul and the joy of achievement in our heart.

---

## MONEL METAL AND STAINLESS STEEL FEATURED AT MEETING OF CHICAGO SECTION

The January meeting of the American Welding Society, Chicago Section, was held on Thursday, January 9th at the Greer School of Automotive Engineering, 2024 South Wabash Avenue. The subject of the program was the "Welding of Monel Metal and Stainless Steel." In spite of the fact that the two previous days had witnessed one of the worst storms of the winter, the meeting room was filled to capacity. The program was given by M. E. Olsen, welding supervisor, of Mojonnier Bros. Co., Chicago, manufacturers of milk machinery. The subject was introduced by a motion picture showing this equipment in actual use and illustrating how it puts the dairy business on a mass production basis and also how essential it is that such equipment offer the greatest possible opportunities for a thorough cleaning. Mr. Olsen then gave a talk in which he explained the reason for using monel metal and stainless steel in various kinds of equipment and the reasons for welding. He then explained the technique used in welding both of these materials with the electric arc and with the oxy-acetylene torch. A series of lantern slides giving an opportunity to study some of these applications concluded the talk. Then the meeting adjourned to the shop where the Greer students receive their shop instruction in welding, and these welding processes were demonstrated by Mr. Olsen. Interest in all the features of the meeting was very high, particularly in the practical aspects of the subject.

---

## GAS PRODUCTS ASSOCIATION CONVENTION

The Midwinter Convention of the Gas Products Association will be held at the Lake Shore Athletic Club, Chicago, January 20th to 22nd. O. E. Engler is president, and E. L. Mills is chairman of the Entertainment Committee.

Papers and addresses include "Trade Practice Conferences," by Parker B. Francis, Kansas City Oxygen Gas Co.; "The Other Eighty Per Cent," by H. S. Card, editor of The Welding Engineer; "Oxy-Acetylene Welding of Copper," by I. T. Hook, of The American Brass Co.; "Gas Welding and Cutting Flame," by M. S. Hendricks, editor, Acetylene Journal; "Welding in Russia," by A. A. Heller, International Oxygen Co.; "The Control of Weld Properties," by R. W. Holt, research engineer, Fusion Welding Corp.; and "Suggested Activities of the Association," by A. J. Fausek, president, Modern Engineering Co. Members will discuss problems of special interest to them, including such topics as methods of compensating salesmen, cylinder turnover, distribution methods and costs, the status of pipe welding in building construction, standardization of gauge sizes, and the trend of gas welding and cutting.

The banquet will be held on the evening of January 22nd. Dinner will be served in the swimming pool room, which will enable the committee to provide aquatic entertainment.

# Automatic Cutting *as a* Business

## Shapes Produced With Less Cost and Time

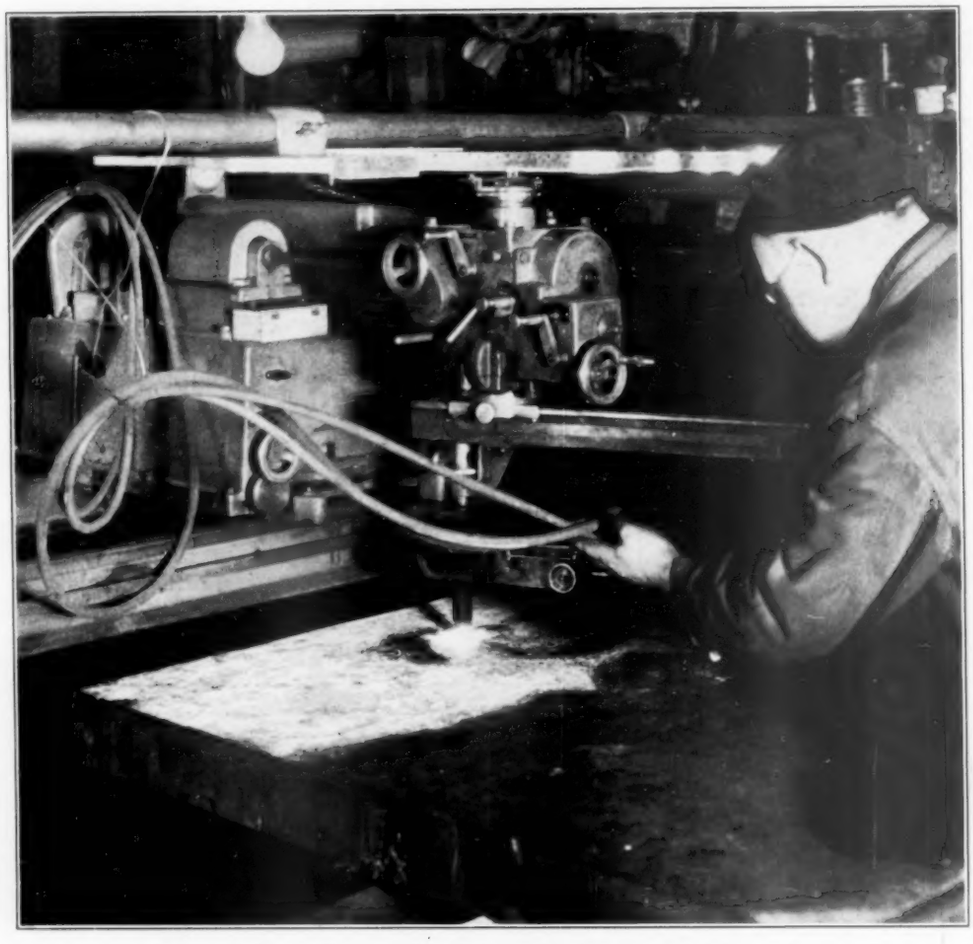


**Fig. 1. Cutting a Bed for a Hydraulic Punch Press out of 4-Inch Stock.**

(Formerly these punch-press beds were made from cast steel. By cutting them out of steel slabs, the cost is lessened and a better product results. Notice the narrow cut, which appears as a line, that the torch has already made. The torch is moving at the rate of 5 in. per minute, and is guided in its course by the pattern mounted horizontally over the cutting head.)

A COMPARISON of the products produced by the automatic gas cutting machine with the shapes obtained by the hand-operated cutting torch is so striking as to convince one that the automatic cutting head marks as great an advance over the hand torch as the latter after its inception held over older methods of severing steel. The cutting torch, heretofore used generally as an agent for tearing down and scrapping, is being used more and more for the cutting of shapes out of plates, and the automatic cutting head is increasing rapidly the prestige of the cutting torch in its new role as a creative agent.

The field of gas cutting opened up by the automatic torch cutter is so imposing that several pages could be devoted only to naming the different classes of products that have been or could be produced cheaply by this method. But the automatic torch has other important advantages: It can cut arcs of circles, angles, straight lines, or any combination of these, without the use of guide lines or patterns. The cut edge of the product is so smooth that no finishing is required, except in the case of a machine fit, and the cut can be made so close to the finished edge that the removal of surface metal of apple-peel thickness is all that is required of the finishing machine. Moreover, the cutting torch in the automatic head can be operated under such complete control and perfect adjustment that gas is not wasted, one tank of oxygen going considerably farther with the automatic head than when used on a hand torch.

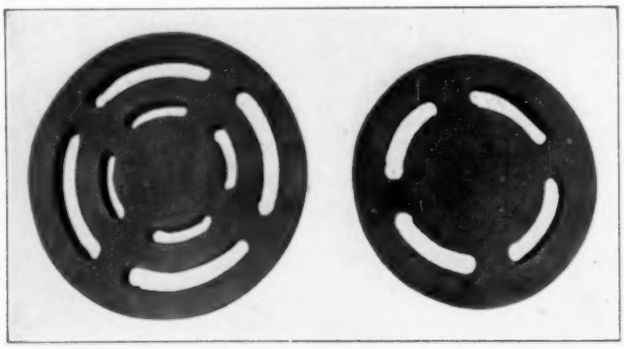


**Fig. 2. Air-Compressor Valve Cut out of 1¼-in. Stock.**

(The ends of the slots first were drilled, then the round slots made on the automatic gas cutter without the use of patterns, and finally the pieces cut out of the stock by making complete circular cuts. The result is a valve that needs no finishing except on the faces. By this method 20 of these valves can be turned out by one man in a day, whereas 5 would be the limit per day if they were made by milling.)

### One Firm's Experience with the Automatic Torch

Typical of what the small welding or machine shop can do with the automatic gas cutting machine is the experience of the Mechanical Engineering Products Co., Inc., 1542 W. Jackson Blvd., Chicago, Ill. This concern makes levers like that shown in Fig. 4 for a large manufacturer of printing presses. Before the installation of their present automatic gas cutting machine, this company machined these levers out of stock three at a time. Now they cut them from plate by means of the automatic gas cutter, and they produce twelve of them for the cost of three by the former process. The many types of products that this plant has turned out with the automatic cutting machine includes compressor valves, car couplers, cams, gear blanks, special gears, clamps, connecting rods, nut wrenches, bed plates for punch presses, etc.

The largest piece of work that this machine has handled was a job weighing about 2 tons and cut out of stock 9½ in. thick. The edges obtained were almost a perfect finish. This job required an oxygen pressure of 150 lb. per sq. in. As a rule, the thicker the work, the higher the oxygen pressure required and the slower the speed of the torch. Circles of radii up to 21 in. can be cut without the use of a pattern. While most of the jobs are cut from mild-steel plate, the torch can also be used on chrome-nickel steel, but tool steel must

be preheated thoroughly before cutting, according to this shop's experience.

When a job of cutting is obtained, the work is first laid out on the stock from which the shape is to be cut. If the job is not intricate and involves only simple lines, no pattern is used. Most jobs, however, require the use of patterns.

### Pattern Used Is Cheaply and Easily Made

The pattern used with this particular machine consists of

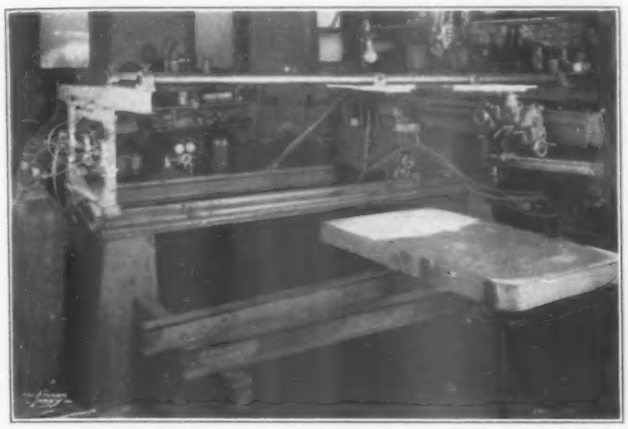


**Fig. 3. View of Automatic Gas Cutting Machine.**
(The stock from which the cut is to be made is mounted on four jacks to obtain a perfect level. Notice that the near corners have already been rounded by the automatic torch. This is the same stock as shown in Fig. 1. The cylinders of cutting gas are on the left of the machine, and the two gas cylinders in the rear are for preheating.)

9/16 in. ply board cut to shape with a band saw and a soft-aluminum strip tacked around the edges. The purpose of the pattern is to guide the cutting head holding the torch, so the torch follows over the plate an outline similar to that of the pattern itself. This type of pattern is inexpensive and quickly made in the shop. Two such patterns are shown in Fig. 4.

The machine consists of a cutting head mounted on two carriages, one allowing longitudinal movement and the other transverse movement, similar to the trolley of an overhead crane. The former, or main carriage, moves on tracks carried

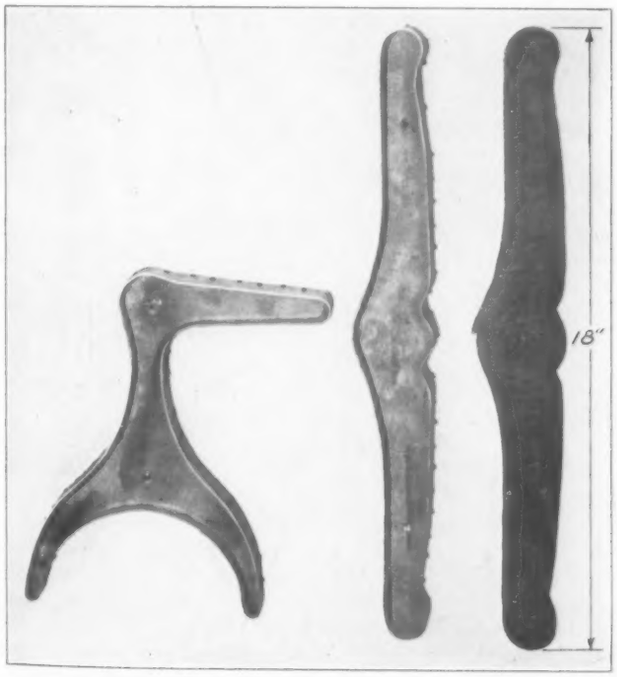



**Fig. 4. Two Patterns for Use on the Automatic Gas Cutter, and One of the Cut Shapes Obtained.**
(Notice that the printing-press lever shown on the right is practically identical in size and shape with its pattern. By automatic cutting four of these levers can be made for the cost of making one by machining. The patterns are made of ply board with an aluminum strip tacked around the edge. No shape, it seems, can be too intricate for this method of cutting.)

by the base of the machine, and encloses the driving motor.

The pattern is mounted in a horizontal position above the work, being held in place by clamps on two adjustable rods running the length of the machine bed. The aluminum lip on the edge of the pattern extends downward and is engaged by two revolving pins, one on each side, which grip the edge of the pattern firmly, being pressed against the guiding strip by the tension of a spring. One of the pins is connected to the driving motor by a shaft and gearing, while the other is allowed to swing on a pivot, adjusting itself automatically to the curves in the guiding aluminum strip.

When a pattern is used, the motor-driven pin grips the pattern edge and travels along it, causing the cutting torch to move over the work in a direction parallel to the movement of the pin itself.

### Cutting of Angles, Lines, and Arcs

Circles are cut without a pattern by setting a lever on the cutting head so it points on a scale to the radius of the circle desired. By engaging the gear that moves the carriage over

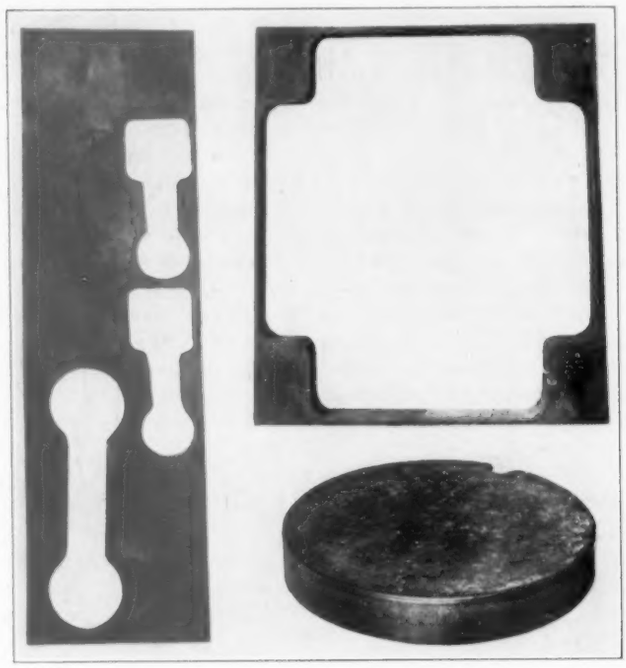


**Fig. 5. Examples of Pieces of Scrap Obtained After Cutting.**
(The piece shown on the left has had cut out of it a crosshead and two other shapes. One of the shapes was not completely cut out, to show how narrow the slit is that is made by the cutting flame. The upper piece on the right is what was left of a 2½-in. plate after cutting out of it a bolster plate for a punch press. The beaded edge which appears over most of the cut was caused by having the tip of the torch too far from the work. The drill hole in the lower right-hand corner was the start of the cut. Notice the almost machine-like finish of the edge of the disc shown at the bottom. This disc is a piece of scrap from a cutting job, which accounts for the presence of the drill hole at the farther edge.)

the bed of the machine, a straight, longitudinal cut is obtained. When this gear is disengaged and the gear operating the other carriage is engaged, the movement of the head is a transverse one and the cut is at right angles with the bed of the machine. The speed of each gear can be adjusted independently of the other. When both are operated together and at the same speed, a cut is obtained at an angle of 45 deg., which angle can be varied by changing the speed of either gear in relation to the other.

The torch can be adjusted vertically while the machine is in operation by twisting in one direction or the other a collar located just above the torch and convenient to the operator; this allows the operator to compensate for any uneveness of the surface of the work. The height of the tip of the torch over the work is an important factor in obtaining a smooth cut.

The linear speed of the cutting torch is recorded in milli-

meters per minute on a dial located on the rear of the main carriage. The lower half of this dial is visible in Fig. 1.

### Sequence of Operation

To cut a job, with the pattern mounted in place, the operator engages the pins, already referred to, on to the lip of the pattern, starting at one end of the pattern or wherever the corresponding mark on the work can be readily located. Then the torch is adjusted by swinging the bar on which it is mounted or moving it in its guides, then locking it, so the torch falls on the work at the point corresponding to the location of the pins on the lip of the pattern. The head is then moved along the length of the pattern without the cutting flame, the operator watching

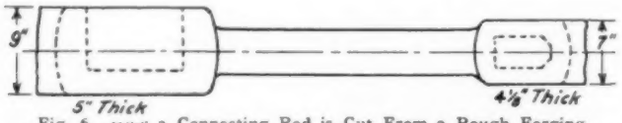



**Fig. 6. How a Connecting Rod is Cut From a Rough Forging.**
(This forging weighs 350 lb. By moving the cutting torch as indicated by the broken lines, a connecting rod for a large engine is obtained. Notice that the thickness of the forging is not the same at both ends.)

the progress of the torch tip over the work to make sure that the outline is being followed. This serves as a check on the pattern shape and on the position adjustment of the torch.

The operator then starts the cut by turning on the preheating flame for a few seconds, then the cutting flame, immediately following which the head is put under the control of the driving motor. As the operator stands in front of the work, all adjustments and controls are convenient for any manipulation that may be required, and the speed indicator is visible. The rate of cutting is predetermined by the thickness of the stock and the oxygen pressure, and the control is set to secure this speed of the torch.

The torch tip is so constructed that the preheating flame is conical in shape and concentric to the cutting flame. Each flame is under direct control of the operator. Referring to Fig. 3, the four tanks of oxygen for cutting are located at one

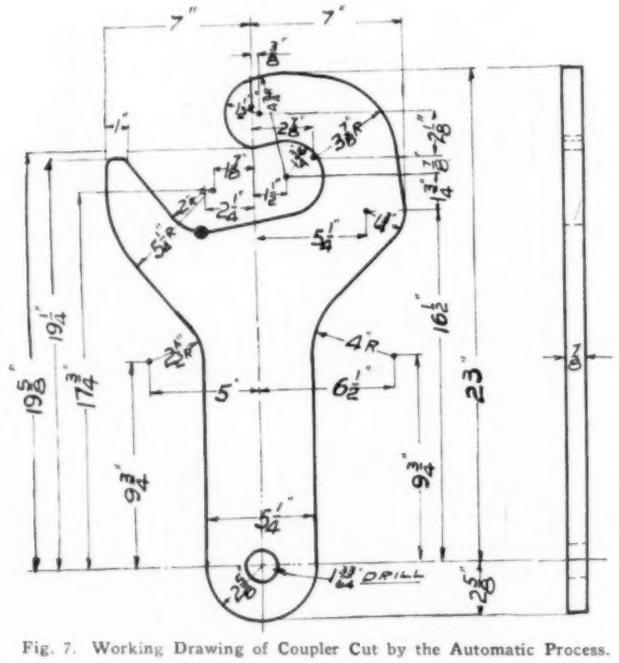



Fig. 7. Working Drawing of Coupler Cut by the Automatic Process.

end of the frame of the cutter, and the oxygen and acetylene tanks for preheating can be seen on the farther side of the frame.

When the cutting must start at some point inside the work instead of at the edge of the stock, as, for example, when an inside circle is to be cut, a hole is drilled by a drill press near the point of starting and the cut is commenced here by putting the torch directly over the hole and then turning on the gas. The hole is drilled in that part of the piece that is to be cut out and scrapped, in order not to damage the work itself. These starting holes are visible in two of the pieces of scrap shown in Fig. 5.

The products of the automatic cutting torch are not limited to pieces cut from flat stock. An engine connecting rod, for example, like that shown in Fig. 6, can first be forged out of steel in the shape shown, then cut by the automatic torch as indicated by the broken lines. It will be noticed that the thickness of the forging is different at each end.

Because of the low cost of cutting shapes from steel slabs and plates, as well as the speed with which the finished shapes can be produced by this method, compared with molding or forging methods, a number of the large industries have come to realize that the automatic gas cutting machine is one of the most valuable adjuncts to production. Moreover, those job welding or machine shops who are the first to recognize its possibilities will build up a large business for themselves in a new field in which there is a large demand and alluring profits.

### The Automatic Cutter as a Business Builder

It is probable that in every large industrial center there are a number of manufacturing plants who need the services of an automatic cutting machine but who do not feel that they have

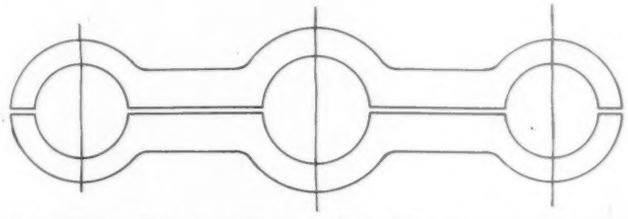


**Fig. 8. Clamps Made by a Simple Method, Using the Automatic Cutting Machine.**
(First a piece is cut out of stock in the shape of two clamps as shown. Then the three circles are cut, and finally the torch is moved over the long axis of the piece. Result: Two clamps that need little, if any, machining.)

enough work for such a machine individually to justify the investment in it. Undoubtedly they would be glad to have the services of a shop specializing in this class of work available. The success and the growing business of the Chicago concern at least is a strong indication. Of course, some of these customers would eventually use so many cut shapes to replace castings and forgings that they would eventually install equipment to do the work themselves, but the experience of the machine shop and the welding shop is that there is always new work coming along to replace the business which is lost when a customer decides to do his own. Right now there are many manufacturers of heavy equipment who are seriously considering the installation of welding equipment in order to replace large castings by welded steel. This will mean a considerable amount of experimental work, and the service of a shop which is prepared to do cutting of odd shapes on a jobbing basis would effect great reductions in the cost of such experimental work.

---

## LARGE JERSEY CITY PROJECT REQUIRES EXTENSIVE CUTTING

The Pennsylvania Railroad in Jersey City have started to tear down the terminal, the old Adams Express Building, and piers, and when the job is completed there will be four city blocks in Jersey City of new buildings, consisting of docks, 1,100 ft. long, with large warehouses and cold-storage plants, new terminal, and ferry docks. Jersey City is spending about $20,000,000 on this improvement, and it is said the Pennsylvania Railroad is spending $30,000,000. Operations on dismantling started December 9th, and about two years will be required to complete the work. At least ten cutting outfits will be used on this job before it is completed.

# The Outlook for the Steel Floor

## A New, Extensive Field for Welding Materials Is Opened Up by the Introduction of the "Battledeck" Floor In Building Construction

THE substitution of welded steel plate and I-beams for heavier materials of construction in the fabrication of floor panels in buildings will result in a lighter-weight and less-costly structure, one that for the same height will allow an increase in rentable area of one floor in every twenty and that can be erected more speedily, according to figures that have been compiled and carefully checked by structural engineers. The possibilities in this direction are so great that two large electrical manufacturers already have developed, or have in the course of development, automatic machines for arc welding the seams of floor plates after laying, and a public demonstration of this type of floor construction was viewed with evident enthusiasm by the members of the American Institute of Steel Construction at their convention held at Biloxi, Miss., on November 14th.

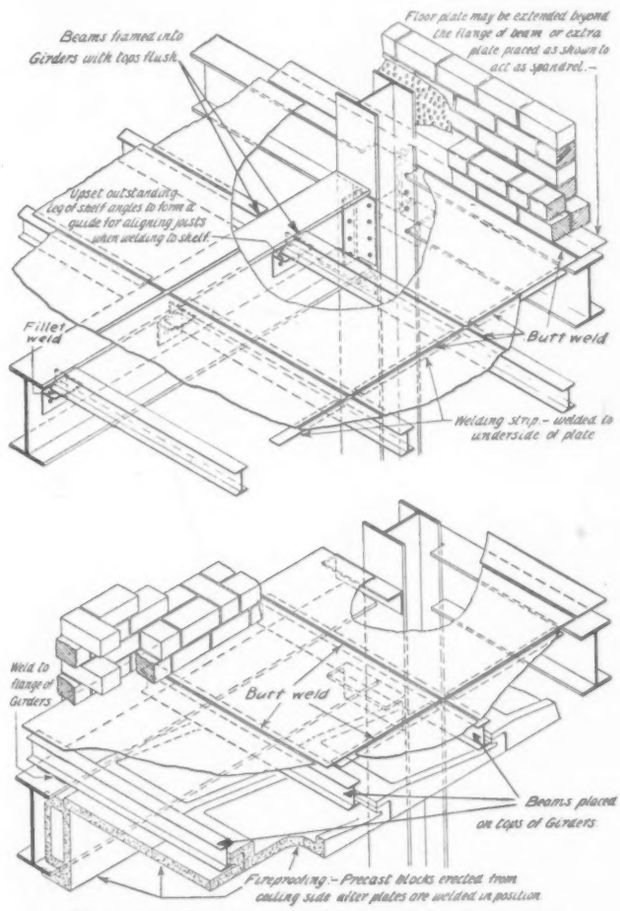

Beams framed into Girders with tops flush.
Floor plate may be extended beyond the flange of beam or extra plate placed as shown to act as spandrel.
Upset outstanding leg of shelf angles to form a guide for aligning joists when welding to shelf.
Fillet weld
Butt weld
Welding strip - welded to underside of plate
Weld to flange of Girders
Butt weld
Beams placed on tops of Girders
Fireproofing - Precast blocks erected from ceiling side after plates are welded in position

**Fig. 1. Two Types of "Battledeck" Floor Construction.**

Moreover, many of the advantages of the battledeck floor, as this type of construction is known, are not lost when the principle is applied to other forms of structure—for example, elevated and surface highways, residences and bridges.

This type of construction apparently has the added advantages that depreciation and maintenance are considerably reduced, the salvagable materials have a greater value, and plaster, concrete, and other materials that represent waste are reduced in amount. None of the advantages, however, detracts from the value of the construction for permanency.

### Importance of Floor Panel Design

According to the American Institute of Steel Construction, probably no part of a building structure, under present conditions, has been more unsatisfactorily developed than the floor-panel construction, and yet it is the only reason for constructing a building. Modern methods of construction involve the use of materials in the floor panels which constitute a dead load that generally weighs considerably more than the live load which is to be supported. This excessive dead weight of the floor panels must be carried into the skeleton frame, girders, and columns, and ultimately to the foundations. It is, says the Institute, therefore evident that one of the conditions which limit the heights of multiple-story buildings will be the capacity of the foundations to carry the dead load of the structure, which is greater than the calculated live load. A reference to the column schedule of a multiple-story building will show that the column stresses for dead loads are often approximately two-thirds of the total stress, the other third being live load.

Engineering practice and code requirements, the Institute explains, recognize that the probability of the contemplated live load being simultaneously applied to all floors of a building is very remote, and therefore it is permissible to assume a very substantial reduction in the specified live load for designing the lower-story columns and foundations of all tall buildings. This permissible reduction does not apply to the dead load which is, of course, always present.

The new flooring, according to the Institute, is better than any floor that has been used before, and will stand every service to which the floor may be subjected. It is a floor in which it is possible to determine in advance the stresses in all parts, and a floor which with proper design will positively recover 100 per cent of any deflection caused by live loads, when those loads are removed. Steel-plate floors have been used for the charging floors of open hearth furnaces and for the decks of battleships where they are subjected to the most severe service known, so their use in buildings is not entirely without precedent.

### Resembles Solid Steel Deck

The new floor is described as being a solid steel deck which acts as a girder to prevent any torsional distortion of the building when subjected to wind or earthquake action. It enables the engineer to select that part of the structure which is to carry the wind stresses to the foundations, and to be assured that the deck flooring will deliver the stresses to the most rigid part of the vertical frame. The floor construction can be carried out into the walls to provide spandrel construction to support the outside walls. This can be accomplished simply by laying the steel plates for the floor panels as soon as the beams are laid and tack welding the plates to each other and to the beams, the final welding operation being performed later. Thus a working floor is provided for other trades and in many cases the necessity of temporary planked floors is eliminated.

The total cost of a floor constructed of 3-in. I-beams and $\frac{3}{16}$-in. plates, covered on the top with cork tile and fireproofed on the under side, is estimated by the Institute as being a little over $1.00 per sq. ft. It is pointed out in this connection, however, that the cork-tile floor eliminates the neces-

sity of any other floor covering, which is always a part of a tenant's expense when using an ordinary masonry floor. The cost of a good chenille carpet alone is from $1.25 to $1.50 per sq. ft., so the welded battledeck floor complete costs less than the carpet and eliminates its necessity.

With the usual type of building construction, the dead weight of the floor is 70 to 80 lb. per sq. ft. The battledeck floor, on the other hand, puts a load on the girders equivalent to only 30 lb. per sq. ft. In connection with a 75-story building, with floor panels 21½x22½ ft., the saving in dead load on the foundations for each column is nearly a thousand tons, thus permitting a 25 per cent increase in building height for the same foundation loads.

The normal floor-to-floor height with battledeck construction is 9 ft. 8 in., compared with the usual 10 ft. 3 in. Yet, with 2 in. of fireproofing below the beams, the floor-to-ceiling height is the same in both constructions. Hence, the battledeck type saves 7 in. per story, and allows the construction of 21 stories in less height than that ordinarily required for a 20-story structure.

### Construction Period Is Shortened

In addition to the saving in cost and the increased rentable area, the building owner is also interested in another factor—namely, time. The quicker a building can be completed to the stage that tenants can use it, the sooner will the owner start to realize on his investment and the smaller will be the carrying charge, which is made up of interest on the investment represented, taxes, insurance, and other items. In the battledeck type of construction use is made of standard fireproofing blocks cast in certain shapes that permit their being

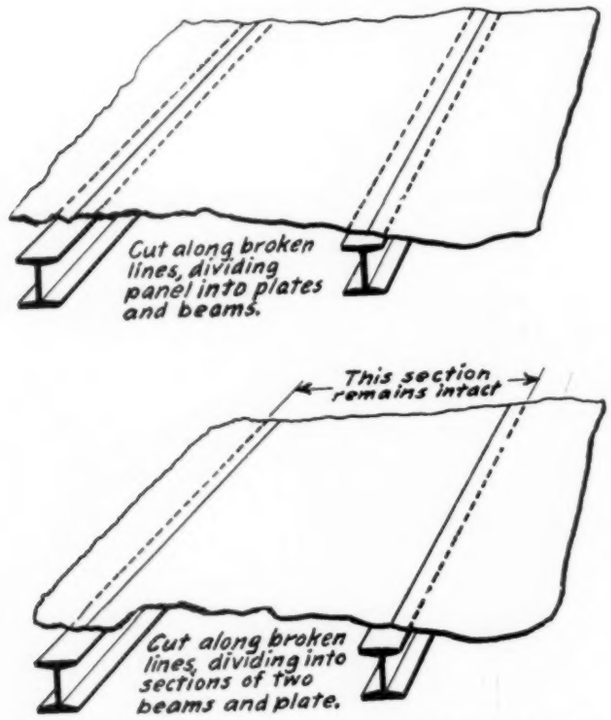

Cut along broken lines, dividing panel into plates and beams.
This section remains intact
Cut along broken lines, dividing into sections of two beams and plate.

**Fig. 2. Illustrating Two Methods of Cutting Floor for Salvaging.**

hung onto the lower flange of the beams and the joints filled to give a ceiling that meets all requirements of fire protection. Blocks of this kind are shown in place in the lower diagram in Fig. 1. The use of such blocks, together with other advantages in design already pointed out, aids materially in reducing the time of erection.

In congested centers where real estate values are ever increasing, or for temporary structures the matter of salvage becomes a serious one. The expense of razing a building is a charge against the new structure or against the value of the ground frontage, whichever way one prefers to look at it. Naturally, if the razing can be made less costly or if more can be realized from the sale of salvaged material, the less will the financial scheme for the new building have to bear. A step in this direction is the substitution of steel for those materials that have little or no salvage value. Steel flooring in the battledeck type of construction can be salvaged to the extent of eighty or ninety per cent, and erected elsewhere in a similar structure; and the beams can be entirely reused, except where they have been framed into the girders, in which

**Fig. 3 Hand Welding a "Battledeck" Type of Floor. Notice the Odd Outline of This Floor. This Construction Readily Adapts Itself to Any Shape or Size of Building.**

case the ends should be cut off flush with the edge of the girder web, resulting in a slight shortening of the beam.

Fig. 2 illustrates two possible methods of salvaging the welded floor panels. In one case the welding torch is run along both edges of the beam flange, thus severing the floor plate from the beams and leaving the welded edges on the beams. When the beam is reused, it is turned upside down with respect to its former position, and the plates are relaid on the unused surface.

### Simple Methods of Salvaging

In the other case shown, the plates are cut flush to only one edge of the beam flange. As the plates are normally 24 in. wide, this operation divides the floor panel into two types of sections that can be readily transported, one consisting of two parallel beams welded onto a 24-in. plate, and the other being a plate about 21 in. in width. In reuse, the beam-and-plate sections are placed a little closer together than in the first construction, so the plate sections will overlap sufficiently to give support. To obtain a smooth surface, the cut edges of the plates that have been left on the beams are turned upward and cut off with a torch. The rough edges are then hammered down, leaving a space for the edges of the plates that are to be welded. The irregular space between the old weld and the plate edge is built up with weld material to the surface of the plate.

### 4½ Miles of Welding in 1,000-Panel Skyscraper

A typical 20x20-ft. welded floor panel will have approximately 240 linear feet of welding, distributed as follows:

| | |
|---|---|
| Longitudinal seams (10x20) | 200 ft. |
| Cross seams (1x20) | 20 ft. |
| Beam-to-girder welds (20x1) | 20 ft. |
| Total | 240 ft. |

The first two items, totaling 220 ft., represent jobs for the automatic welding machine. The last item is one for hand welding.

In computing the extent of welding required in this type of construction, it is easy to remember that ½ ft. of welding for every square foot of floor space is the requirement for the longitudinal seams, which represents about five-sixths of the total welding. Using these figures for a 44-story skyscraper, with a 125x125-ft. base, and the upper 22 floors built as a setback, we find that approximately 1,000 panels will be used in such a structure, thus requiring 240,000 linear feet, or 45½ miles, of welding.

### Automatic Welder for Floor Plates

The special machine demonstrated at the Biloxi convention of the American Institute of Steel Construction, Inc., for the purpose of automatically welding steel floor plates, was designed by the General Electric Co.

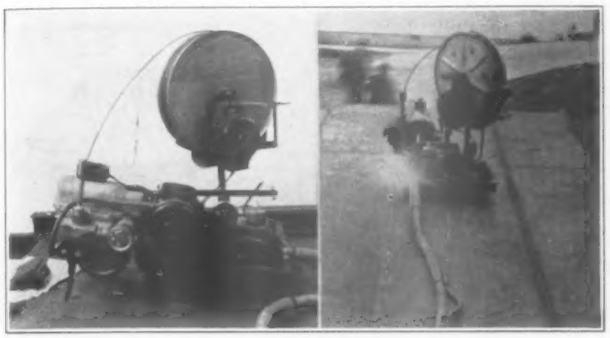


**Fig. 4. Automatic Welding Machine for "Stitching" the Seams of the Floor Plates.**

This machine, referring to Fig. 4, consists of a three-wheeled self-propelled vehicle driven by an adjustable-speed motor. On the framework are mounted a wire-feeding device, a reel of welding wire, the travel motor, and the control devices—all occupying a space of less than 5 sq. ft. and having a height of 2 ft. A motor-generator at a remote point supplies, through a trailing cable, the current for welding and for operating the travel motor. The speed of travel and the speed of the welding-wire feed can be varied easily by adjusting small rheostats, thus making it possible to suit the operation to any particular set of circumstances. In the demonstration at Biloxi a completely satisfactory weld was accomplished at a speed of 9½ in. per min.

**Fig. 5. Steel Construction Delegates to the Biloxi Convention Inspect the Automatic "Stitcher."**

In operation the machine is placed on the beginning of a seam, where it is lined up and started running. If by any chance it should tend to deviate from the seam during the course of travel, it can be easily steered by means of a small steering wheel on the mechanism. At the end of the seam it is merely necessary to turn the machine around and place it on the beginning of the next seam, proceeding from this point as before until all seams are welded.

The Westinghouse Electric & Manufacturing Co. also has developed an automatic welder for this purpose, on which a seat is provided for the operator, who guides the machine. This same company is developing a smaller automatic welder for work on which the other welder is not feasible.

Fig. 3 illustrates a battledeck type of floor being welded by hand. This view was taken from approximately the point where the building entrance is to be located. Wings, not shown in the figure, extend to the left rear and right rear. Because of the V shape of the building and a frontage of peculiar shape caused by street intersections, the particular section of the building shown would have presented an involved problem in structural design if ordinary methods of floor construction had been used. The battledeck type of construction, on the other hand, adapts itself readily to any shape.

This construction can be readily applied to highway bridges and viaducts, in which case the steel plates may be surfaced with asphalt. Repairing would merely necessitate the removal of the bad spot and the inlaying of an asphalt strip cut to size, which operation can be done quickly by machine and at small cost.

### Advantages in Elevated Highways and Bridges

The further advantage of light weight and hence lighter foundations and structural work is had in the case of elevated superhighways, viaducts, and bridges. With ¼-in. plate, and 10-in. beams spaced 20 in. center-to-center, the weight of the floor is given in the A. I. S. C. specifications as 35.64 lb. per sq. ft. The asphalt will weigh about 10 lb. per sq. ft., making a total weight per square foot of approximately 45½ lb.

Bridges made by this method can be dismantled with barely any wastage, when they become inadequate to handle the traffic, and the parts transported elsewhere and reerected on a smaller-traffic artery.

Where dense-traffic lanes cross navigable streams, a very considerable part of the total time that bridges are open for the passage of boats is consumed in the operations of opening and closing the bridges. With lighter-weight structures, this time should be somewhat reduced, with a corresponding increase in the time that the bridge is cleared for land traffic. The saving in weight of movable bridges is very considerable.

One of the state highway commissions recently designed a plate girder draw-bridge span employing the battledeck type of floor, in which the head room and the dead load were reduced and several thousand dollars saved in cost. This construction also provides a lateral rigidity that is more satisfactory than any lateral floor diagonals now used.

### In the Residence Field

Several residences already have been built employing the battledeck construction, and some structural men anticipate a rapid increase in its employment in this field as its fireproof qualities and the advantages of rigid construction become more apparent. The high resistance of steel plate to fire is common knowledge. Proper steel construction not only confines fire, but produces a rigid structure in which sagging floors and ceilings are unknown, and these are contributing causes of cracked and falling plaster and distorted door and window frames and woodwork.

As the battledeck floor increases in use, undoubtedly new applications will be found. In time it is bound to become a very important field for the use of welding material.

## NEW JERSEY SCHOOLS WILL TEACH PIPE WELDING

The vocational schools of Essex County, New Jersey, in which county Newark is located, are organizing evening classes intended to instruct steam fitters in the art of pipe welding and have gotten so far along in their preparation, that welding equipments have been ordered and contracts signed for the gas they will require.

Further, a nearby steam fitters' union is very much interested in having a welding class formed in connection with their local and it is expected that such a school will be started in the course of the next two months.

"We find, in this territory," writes W. F. McKay, of the International Oxygen Co., "that considerable interest is being shown by steam fitters, both contractors and workmen, in the art of pipe welding and that there appears to be a general recognition of the fact that the trend of pipe construction is towards welding, and they are apparently extremely desirous of preparing themselves to do this work when the time comes."

## NOVEL WELD MADE IN HUGE CASTING

The welding of a cast-iron steam condenser housing for a large power plant was a problem that confronted me six years ago while working for a large automobile company. This casting weighed about 80 or 90 tons, was 22 ft. in length and 18 ft. in diameter, and resembled a huge pipe with a tee connection. The walls were about 2½ in. thick, and the flange 5 in. A crack extended from the tee connection to one end of the casting, a distance of 12 ft., and when shaken out it was about 2½ in. out of line at the fracture.

It was necessary first to force both sides of the fracture into line, the work being ably supervised by the foundry superintendent. By means of a 125-ton crane, the casting was rolled

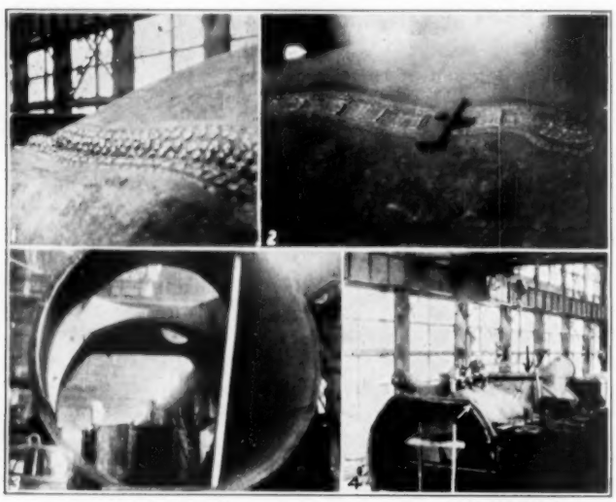


**Fig. 1—Start of Weld; Steel Studs in Place and a Bead Put Around Each. Fig. 2—Weld Half Completed. Fig. 3—Interior of Casting; 2x8-in. Plank Put Inside as Brace to Aid Bolt and Plate Clamps. Fig. 4—View of Crack Prepared for Welding; Crack Is Shown Between Arrows.**

back and forth, at the same time the turnbuckle clamps around the casting being gradually drawn tighter, until alignment was obtained.

The stud-weld process was used, in which holes are drilled and tapped on each side of the fracture and steel studs inserted to give a steel face on which to weld. The studs consisted of machine bolts with their heads cut off by bolt cutters.

The crack was V'd out to a 90-deg. angle by means of a pneumatic chipping hammer, followed by the drilling and tapping of about 1,000 holes to receive the ⅝-in. studs. Three rows of studs were inserted in each side of the V, and three on the outside, both outer rows being set in grooves cut in the casting. The studs in each row was staggered with respect to those in the adjoining row, this allowing the welder better to manipulate his electrode. The depth that the stud was set in the casting was dependent on its position in the V and on where the shearing strain came.

The welding was started by putting a bead around each stud by means of the electric arc and filling up between the studs on each side. The welder would jump anywhere along the break in the casting to prevent too much heat in one place and the resulting stresses. This method gave a facing of steel, instead of cast iron, to weld to on both sides of the V, thereby making possible a stronger joint.

Now came the jointing of one side to the other, in which great care had to be taken not to heat long in one place, in order to avoid such local expansion and contraction as might cause cracking. This was done by jumping to different spots along the weld and welding for only a short time in each place, thus giving a fairly uniform heat along the weld. All jointing was done by welding beads across the line of break and not along the line of fracture.

Low-carbon-steel welding electrode was used on the crack and monel metal where machining was to be done, thus insuring a soft machinable weld, which is not obtainable with steel on cast iron.

This was a very slow process and took approximately 230 welding hours. The preliminary time for chipping, drilling, tapping, and studding was 40 hours. No doubt the entire operation could have been done in much less time; but owing to the large size of the casting and the position of the crack, it was deemed advisable not to take any unnecessary risks. The regular cleaning and chipping of the casting was carried on during the welding operation.

Of the welding electrode used, 450 lb. was steel electrode and 25 lb. monel metal. This casting has been in continuous service since welding.

## WORK UNDER WAY FOR 1930 METAL CONGRESS

Reports received from Mr. W. H. Eisenmann, Secretary of the American Society for Steel Treating, indicate a keen interest in the National Metal Exposition which will be held this year during the week of September 22nd at Chicago. The Cleveland exposition last fall was so decidedly successful that there has been very insistent demand from many exhibitors for larger spaces at Chicago. Negotiations are now being made to secure the largest possible amount of exhibit space in order that the requirements of all manufacturers can be met. Since the final arrangements are not completed, Mr. Eisenmann is not yet prepared to furnish floor plans but states that they will be available by March 15th at the latest and possibly a month earlier than that. There are a number of manufacturers who did not secure space at the Cleveland show but who contemplate arranging for an exhibit at Chicago. Those manufacturers should communicate with the American Society for Steel Treating as early as possible so that those in charge of the preparation of floor plans can come as close as possible to an accurate estimate of how much space will be wanted by each manufacturer.

Chicago is well known as a wonderful convention city. For the welding industry, it has two outstanding advantages—one, that of being the great transportation center for the entire country, and the other being that it is a great center for the manufacture and fabrication of metal products of all kinds. The annual fall meeting of the American Welding Society, which is held during the period of the National Metal Congress, has acquired a great reputation on account of the excellent technical sessions which have been arranged for this meeting in previous years. This splendid series of meetings, coupled with the opportunity to inspect new processes and new materials at the exposition, and the opportunity to meet with other engineering groups in the metal working industries, is a pretty safe guarantee that there will be a large attendance and that it will be composed largely of industrial executives in search of more welding information. It promises to be the big welding event of the year, and it will be worth attending for any man who is interested in welding processes and their industrial applications.

# Fundamentals of Resistance Welding

## This Process Bids Fair to Revise Production Methods Because of the Simplicity and Economy Inherent in Its Application

By Wm. E. Smith†

IN MANY instances, when welding is mentioned, it is regarded as a means of repairing or salvaging broken parts to save the cost of replacing with new parts, and it is only in manufacturing plants that welding is considered as a method of production to help produce the original part at a saving in cost over regular machine-shop practice. The oxy-acetylene and electric arc methods are used extensively where advisable. Both methods, however, are slow in comparison with the speed of operation which is thought necessary in mass production schedules. This fact must be considered, especially in the construction of automobile bodies and parts and similar products.

In designing parts the engineer's first thought should be that of safety, then that of cost, with due consideration to practical production, which, of course, includes the chance of failure due to improper training of operators. The last mentioned item is a big factor when it is necessary to take unskilled laborers and train them to become skilled operators of any machine, welding or otherwise.

The principle of resistance welding is not new, although its field of application has been greatly limited for many years, due no doubt to lack of positive knowledge and of properly designed machines.

Resistance welding is just what its name implies, the heat is generated by the well-known principle of electric current passing through material which sets up a resistance to the passage of the current.

No doubt, we have all watched the old-time blacksmith welding tires for wagon wheels, or welding some other two pieces of metal together. First, he obtains the proper heat by placing the parts in an open fire, bringing the molecular action to a high state of vibration; then he laps the tire ends and applies the pressure required for uniting the ends of a series of blows from a hammer.

The same principle with a modern application is used in the resistance method of welding, the heat being generated by electric current passing through the parts to be welded and the pressure applied mechanically by means of levers and toggles; for heavy work it is advisable to use hydraulic pressure.

### Resistance Welding Dates from 1886

Investigation shows that patents for resistance welding were issued to Elihu Thompson on Aug. 10, 1886; however, it is only recently that this method of welding has been recognized fully as a means in which production can be increased and costs decreased.

The first welding machine was a very crude affair when compared to modern equipment. It was a heavy frame built of wood containing a transformer, with connections leading from the transformer to the two copper electrodes which gripped the work. However, through a natural stage of development the modern welding machine has reached the point where it compares favorably with our most modern production machinery.

The two most common applications of resistance welding are butt and spot welding. The butt method consists of butting two ends together, while in spot welding the two ends are overlapped and a series of spots made, similar to a riveting operation.

A butt-welding machine consists of a frame, preferably of non-magnetic metal (otherwise there will be a loss of current due to the induction of the magnetic flux in the frame), and a transformer of the correct capacity with leads from the line to the primary, and one turn for the secondary, the ends of which are fastened to platens of copper, to which are attached fixtures for holding the work. The secondary voltage ranges from 2 to 8 volts and the secondary amperage varies according to the size and volume of metal to be welded. The primary circuit is opened and closed by means of a breaker controlled by the operator with a small lever attached to the upsetting lever of the machine.

One platen of the welder is stationary and the other movable. The movable one is controlled by a lever and toggle capable of delivering the correct pressure to bring the work together when heated. It is important that the platens be well insulated from each other, otherwise a short circuit would result. The platens are made of copper, as it is the best known commercial electrical conductor, being surpassed only by silver, for high production the platens must also be water cooled. Because of the low voltage used it is necessary to scrape the surface of the platens to get a good electrical contact. There must be proper guards to protect the slides and the transformer from the welding flash—the small particles of molten metal which flash from the work while heating—as this acts the same as an abrasive; also, it will burn the insulation from the transformer, making rewinding necessary.

Fixtures of course are designed to suit the requirements of each particular job, the designer bearing in mind that speed of loading and unloading is an essential factor in reducing costs. The fixtures, like the machine, must be of sturdy construction to withstand the strain of production and must be built of a metal that is a good conductor—copper, bronze, or an alloy that combines strength and good electrical conductivity, and should be water cooled. The dies or electrodes are made as inserts, so that they can be easily replaced when worn; always bear in mind the necessity of keeping all joints fitted and clean.

### With Proper Design, No Preheating Is Required

The work to be welded should be of the same area at the point of contact and should be designed by the engineer so as to obtain this condition, otherwise a preheating operation will be necessary, either in a furnace or by jumping the current on the welder to the heavier piece. This insures the same heat for both pieces. If this is not done, the smaller piece heating faster than the larger would result in a cold weld, which would mean a failure.

Clamping must be rigid and tight to eliminate slippage and the possibility of misalignment. Also, the work must extend from the jaws far enough so that the dies will not conduct the heat away from the weld; there is no set rule in this regard as conditions vary with the metal to be welded, also the size and shape, therefore much depends on the ingenuity of the operator or machine setter and his experience. One approximate rule for low carbon steel is as follows: The opening between the dies after the weld is finished should be equal to the diameter of the stock welded; this applies to solid stock only. For tubing it is much less, depending upon the wall thickness as well as the diameter. Also, the conditions will vary with high carbon steel and non-ferrous metals.

To make a good flash butt weld, bring the work together and flash to burn off the uneven edges. Then butt the ends tightly together, and heat to just under the melting point. Release the

†*Welding Engineer, Murray Corporation.*

pressure and bring the ends together slowly and flash again, which brings the metal to the molten state. Continue flashing up to the upsetting point, when the circuit is opened and pressure applied instantly through the lever and toggle, thereby uniting the two pieces of metal. If the proper procedure is followed, the strength of the weld will equal that of the parent metal; in fact, tensile tests have shown that where it is not necessary to remove the upset metal, the weld is the strongest point.

There are some special alloys that have not as yet been successfully welded by the resistance method, but they are few and we may consider them in the experimental stage as far as resistance welding is concerned. Carbon steels probably more than any other are welded by the resistance method, because they are more universally used, but with new alloys coming on the market it will be necessary to find ways of welding them all. The first requisite of metals to be resistance welded is that they must set up a resistance to the passage of electric current to some degree; this is necessary to produce heat, for without heat we cannot weld.

The welding of high-speed steels, used so much for tools in the machine shop, is very successful; also high-speed steel is united to machine steel, making an idea tool for machine work and showing a saving in cost due to the elimination of scrap ends of the high-speed steels. Brass can also be united to steel by the resistance method; and although we know of no instance where this particular combination might be used to advantage, it is interesting to know that it is possible.

### Butt Welding Reduces Cost of Forged Parts

The cost of forgings is greatly reduced by resistance welding. Where a forging might be desirable and really necessary, but prohibitive because of costly dies due to shape or size, it is possible to make it in two or more parts and weld these together, producing the best product at a low cost. It may be found that a certain part requires the strength of solid metal or forging and at the same time the part must be of light weight. This combination can be obtained in two ways: first, a costly machining operation of removing metal; or second, by welding. As an example of welding, consider a shaft; the ends can be made of forged steel, heat treated and machined, then welded to a piece of tubing, producing a finished part equal in strength to a solid shaft and at a great saving in cost.

It is possible to weld parts together and maintain accuracy to a fine degree by machine finishing the parts to size before they are welded, thereby reducing the machining cost to the minimum.

Resistance welding is fast gaining a place in production because the advantages gained are twofold: a *better product* at a *lower cost*. Resistance welding must, of course, prove its worth over older methods. This it is doing every day; and the time is not far distant when resistance welding will be the chief factor in production, because manufacturers are fast learning of its advantages.

There is nothing haphazard about this newest method of manufacturing; in fact, it requires considerable study and experimenting. Some factories create a special department for developing the parts as well as the machines and fixtures for welding, which has proved to be a good investment, as the result is a better product at a lower cost.

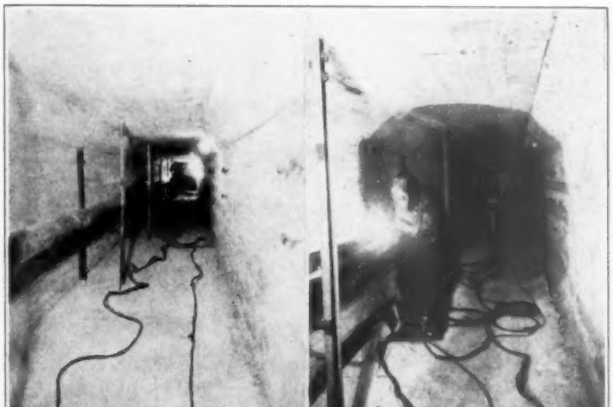
## ANNUAL MEETING OF COMPRESSED GAS MANUFACTURERS' ASSOCIATION

A variety of excellent papers will be presented at the annual meeting of the Compressed Gas Manufacturers' Association, to be held January 28th at the Hotel Astor, New York City. The business session will include the election and installation of officers for 1930. The annual dinner will be held in the North ball room of the Hotel Astor.

The subjects of papers to be given are: "Helium," by E. G. Luening, of the Helium Co.; "Gas Compression and Compressors," by a representative of the Ingersoll-Rand Co.; "Tank Cars for the Transportation of Gases," by a representative of the American Car & Foundry Co.; "Nitriding," by H. A. DeFries, of the Ludlum Steel Co.; "Underwater Cutting of Metals," by C. Kandel, of the Craftsweld Equipment Corp.; "Liquefied Petroleum Gases," by W. B. Campbell, of the Philfuels Co.; "Developments in Cylinder Testing," by F. Eder, of the Robert W. Hunt Co., engineers; and "Developments of the Welding Industry in Russia and Its Place in the Industrial Plan of That Country," by A. A. Heller, of the International Oxygen Co.

## ARC WELDING UNDERGROUND STEAM PIPE

The welding of over 800 ft. of 8-in. steam pipe in a tunnel at the University of California, Berkeley, Calif., was accomplished by running an extension cable consisting of 10 strands of No. 14 r. c. wire, from a Shrader portable welder to the work, according to Charles Wall, manager of the Berkeley Electric Welding Service. Steam fitters aligned each section of pipe on the hangers as the welding progressed. Fifty-eight joints were welded in this line, and also three sleeve-type expansion joints. Flanges were screwed to short lengths of pipe and these welded into the main line for expansion-joint connection. The flanges then were welded to provide a steam-tight joint at the screw ends. The tunnel has one change in pitch, two changes in direction, and one offset.



**Current Is Brought to the Point of Welding by Extension Cables.**

## IOWA ENGINEERS WILL INSPECT WELDED BUILDING

During the Annual Convention of the Iowa Engineering Society, which is to be held at Council Bluffs, Iowa, February 5th, 6th and 7th, the Paxton & Vierling Iron Works, of Omaha, Neb., manufacturers of structural and ornamental iron and steel, have invited members to visit the Omaha plant during the afternoon of February 5th for a special demonstration of welding. It is planned to have several welders working and to provide a good display of welding products; and also give them an opportunity to inspect the all welded ornamental iron shop which was described in a recent issue of The Welding Engineer. This firm has done a considerable amount of pioneer work in structural welding in their neighborhood, and the inspection trip should furnish a good deal of interesting information to those who attend the meeting at Council Bluffs.

# The Status of Pressure-Vessel Welding*

## Restrictions on Welding of Boilers and High-Pressure Vessels Are Being Loosened With the Application of Procedure Control

By C. W. Obert†

THE past four or five years, have witnessed a marked change in the position held by fusion welding in the boiler, pressure-vessel, and piping fields. Part of this is due to a change in public opinion, and part to improvements in welding processes and practices; probably the latter is the underlying cause. This favorable tendency warrants our consideration of some of the recent developments and their effect upon the oxyacetylene industry.

### Progress of Boiler Welding as Affected by Codes and Laws

Undoubtedly one of the controlling factors relating to welding in boiler construction and repairs in this country has been the A.S.M.E. Boiler Code, which is operative in 19 states and 15 cities of the United States. This Code, which is the result of the great uniformity movement that took form in 1911, permeates all the stationary-code jurisdictions in the United States with the single exception of Massachusetts—the pinoneer state in enforcing boiler regulations; the Massachusetts law was introduced in 1906, five years before the uniformity movement that centered around the A.S.M.E. actually began, and the authorities in that state have never seen fit to join hands with neighboring states to the extent of accepting A.S.M.E. Code constructions. The remaining 28 states of the Union have no regulations or restrictions on boiler construction or operation.

When the A.S.M.E. Boiler Code was first written in 1914, the rules therein were limited to customary forms of riveted and forge-welded construction, and no reference was made therein to fusion welding as applied to either boilers or pressure vessels. The art of welding at that time had not developed to the extent that it has now, and lack of authentic data on the strength of welded joints did not allow the formulation of rules for fusion welding. During the years that followed the issuance of the Boiler Code, requests came to the Committee to investigate the new art of joining metals, and since 1916 the subject has been before the Committee in one form or another almost continually. The Committee has attempted to cooperate with individuals, organizations, and governmental bureaus in the endeavor to provide for recognition of welded joints; but it was not until quite recently, when definite cooperation was established with the American Welding Society, that it received real assistance.

As the situation in the boiler field now stands, there are still no established provisions for welded construction in a broad sense, other than for heating boilers for operation at pressures not exceeding 15 lb. for steam and 160 lb. for water heating, which may of course be wholly welded under the Heating Boiler Code. However, the Boiler Code Committee has taken some advance steps in the pressure-vessel field which are reacting favorably upon the boiler field, and it is more than probable that some large-scale developments in boiler welding will be heard of before long. It can be said, however, that welding is now admissible in power-boiler construction to a considerable extent. In a number of details, opportunities have been found for applying welding, and some of these will be outlined here.

The applications of fusion welding that are most generally used in boiler construction embrace a number of important elements, among which may be named the joints in boiler furnaces of both the staybolted type and the self-supporting type. These joints are now quite generally welded, for they are subject to compressive stresses only. Also, the seal welding of tube ends has been quite extensively practiced in fire-tube boilers, particularly in railway-locomotive practice. In addition, fusion welding has for some time been used for the attachment of inserted nozzles, threaded outlets, brackets, supports, and other mechanical fastenings to boiler shells for the connection and support of piping, auxiliary apparatus, and structural details. With the recent rather extensive revision of Par. P-186 of the A.S.M.E. Code, the welding of turned-in flanges of firedoor and similar openings and of flanged-in edges of waterlegs has been made practicable; supplementary to this is an official interpretation that permits the welding-in of rings formed of steel plate for furnace-firedoor openings. As experience in the practical application of fusion welding develops, new mechanical applications of welding to boiler construction are continually being found.

### Welding May Spell Doom of Dreaded Caustic Embrittlement

One of the most interesting features of welding development now actively before the boiler experts is the promise offered by welded joints in the prevention of "caustic embrittlement". There is a growing opinion that if boiler drums could be welded throughout so as to eliminate the microscopic cracks and seams that exist in riveted joints, the tendency toward concentration of caustic salts therein and consequent embrittlement of the plate would be eliminated. Unfortunately, however, no attempt has as yet been made to experiment with this application of welding under proper working conditions, although it is being definitely considered in a number of plants in which this type of trouble has been experienced. If the loss of riveted drums from embrittlement cracking should continue as it has during the past few years, it is quite certain that we shall soon learn of experimental installations of all-welded drums for water-tube boilers.

In the State of Massachusetts, welded construction has virtually been limited to low-pressure heating boilers; and even for that class of boilers, cylindrical shells must have riveted longitudinal joints in any case, indicating very limited faith in welded seams. As far as the writer is informed, no boilers have been admitted to that state for power purposes with any but some of the most minor and unimportant details welded.

In the Canadian Provinces, the situation is quite similar in a general way to that in Massachusetts, although the Conference of Canadian Chief Inspectors is cooperating actively with the Boiler Code Committee, and they seem to be inclined to advance in all matters of this kind with the practice that develops on this side of the border line. In all the Provinces, I think, welded low-pressure heating boilers are admissible. Also a number of the Provinces have accepted certain of the details enumerated in preceding paragraphs for power-boiler construction, as a result of cooperation with the Boiler Code Committee. Ontario has taken an advance step in signifying its willingness to accept welded boiler drums for high-pressure operation, provided the process and construction methods meet the approval of their inspection department.

### Requirements for Unfired Pressure Vessels

The A.S.M.E. Unfired Pressure Vessel Code exemplifies the first tangible results of the intensive studies of fusion welding made over a period of many years by the Boiler Code Committee. When it was issued in 1923, it was considered an important

*Paper read before the International Acetylene Assn. Convention, Chicago, November 13-15, 1929

†Union Carbide & Carbon Research Laboratories, Inc., Long Islanh City, N. Y.

advance, but the limits imposed therein on the application of welding were such as to narrow the use of welded construction principally to air-pressure tanks of comparatively small sizes. This was naturally disappointing to those interested in the advancement of the welding art; but in the absence of the much-looked-for means of measuring the strength of a welded joint, the limits—namely, 20 in. in diameter, length not to exceed three times the diameter, working pressure of 100 lb. per sq. in., plate thickness of 5/8 in., and unit working stress of 5,600 lb.—represented the best that could be agreed upon by the Boiler Code Committee, which would at the same time prove acceptable to the inspectors' organization.

While very few states and cities have accepted the A.S.M.E. Unfired Pressure Vessel Code, the State of California took action in 1926 toward adopting the essentials thereof, except that it broadened the limits on welded construction considerably over those in the A.S.M.E. Code; for instance the diameter limit was increased to 60 in., the pressure limit to 200 lb., and the unit working stress in double-V longitudinal joints to 8,000 lb. per sq. in. The Boiler Code Committee gave its sanction to the changes from its Pressure Vessel Code, provided only that the State could enforce such regulations and restrictions as would insure sound and safe welding. This the California Department was able to establish by a form of registration for manufacturers, and their code went into effect on January 1, 1928. So far as the writer has been able to learn, the results there have been generally satisfactory.

Since the original edition of the Unfired Pressure Vessel Code was issued, the American Welding Society has been working to liberalize the established rules for welded construction, and a step of great importance was taken when it formulated a Recommended Procedure for sound and safe welding, which was formally presented to the Boiler Code Committee last February. This Recommended Procedure established for the first time in code work, a set of rules for welded construction, which if followed out could be expected to insure safe welded vessels. The Boiler Code Committee, after making a study of this Procedure, decided that it promises to furnish that connecting link between fusion welding and safe, sound construction which is so greatly needed, and, using it as a foundation, took steps so to revise the Unfired Pressure Vessel Code as to render it uniform with the California code. These revisions are now in process, awaiting publication before being officially approved and issued. Some delay has been incurred as a result of criticism of certain details of the new Procedure, but this criticism has now been ironed out by the Conferring Committee of the American Welding Society, and it is expected that this revision will be completed before the close of 1929.

The above-mentioned revisions of the A.S.M.E. Unfired Pressure Vessel Code will eliminate the present limitation of fusion welding to air vessels only, and will extend the diameter limit from 20 to 60 in., the pressure limit from 100 to 200 lb. per sq. in., and the allowable unit working stress for double-V longitudinal welds from 5,600 to 8,000 lb. per sq. in. Supplementary provisions are also made for allowable unit working stresses of 6,500 lb. per sq. in. for butt single-V girth or head welds, 7,000 lb. per sq. in for double full-fillet lap or girth welds, and 5,600 lb. per sq. in. for spot or intermittent girth or head welds.

### New Field for Qualified Welders

These extended limits are applicable, however, only in case that the Recommended Procedure, which is to be issued together with these revisions, is followed in detail, and the vessels are fully inspected during construction and at the time of hydrostatic test. It is provided in the Code that if the requirements of this Procedure are not followed, the limitations that formerly existed will continue to apply. The net result of this new departure is that only a well-equipped fabricating shop with qualified welders and considerable experience concerning pressure-vessel construction will be in a position to take advantage of these new rules. This advance step taken by the Boiler Code Committee appears to be well thought out and wholly justified from every point of view.

As a result of this activity in welding rules, the State of Ohio has recently taken action to adopt the A.S.M.E. Unfired Pressure Vessel Code with the above-mentioned modifications included; these new rules will go into effect in Ohio on January 1, 1930. Oregon, which was one of the first states to enforce the rules of the Unfired Pressure Vessel Code, is now taking steps to modify the rules in accordance with the revisions under consideration, and thus keep its code up-to-date. Similar moves are being talked of in the cities of Seattle, Wash., and Detroit, Mich., although the author has not as yet learned of definite results. The states of New York and Pennsylvania have given some study to the question of pressure-vessel rules, and may perhaps take action thereon within another year or so, if these revisions to liberalize the welding rules meet public approval and work out satisfactorily. The chief boiler inspector of New Jersey also favors the revision in question, and is preparing to act along similar lines.

Massachusetts has air-tank regulations which, like its code for boilers, make no provisions for fusion welded construction of any character. Its air-tank code appears to be an abridgement of its core for boilers, as the detailed rules for riveted joints and other items therein are an exact duplication of those in the boiler code. It is, therefore, evident that the scope of neither of its codes has been extended to embrace the developments in fusion welding.

The Canadian Provinces, while slow in this respect, have shown better progress than Massachusetts. Most of the Provinces have formulated rules for pressure vessels, but not all of them have given adequate consideration to fusion welding, the absence of rules for welding being usually construed as prohibition thereof. British Columbia has adopted the A.S.M.E. Unfired Pressure Vessel Code, in toto, and therefore accepts welded construction to a limited extent. Ontario has been the most progressive in this respect, as it accepts welded construction for all sizes and pressures, provided only that the process and construction methods meet the approval of its inspection department.

### Trend in Welded Pressure Piping

Greater advance in fusion welding has taken place with regard to piping in power and heating plants than in the boilers or pressure-vessel field. This is due perhaps to the general absence of restrictions of a legal nature pertaining to such construction. In very few localities will steam or other forms of power piping be found legally restricted as to construction or repairs. This has allowed the designing as well as the construction forces to use their best judgment in the fabrication of their piping, including valves, fittings, etc., so that the greatest durability and freedom from trouble could be provided for. Fusion welding has found this field an unusually fruitful one, in view of its particular adaptability to the types of fittings and classes of materials used therein.

Probably the greatest single impetus was given to this development by the large industrial plants that maintain both piping and welding gangs. Under emergency conditions, their welders would be called in and found to be able to handle erection or repair work in a safe and dependable manner in a fraction of the time needed for the ordinary threaded or flanged-fitting methods of piping. It is well known that the quality of low-carbon steel used in making ordinary commercial grades of pipe lends itself admirably to this purpose and has greatly facilitated not only the early attempts, but also the more general use of the process. As a result, the possibilities of welding were soon demonstrated, and its use has thus developed from experimental and emergency attempts to large-scale operations.

The particular type of welding operation that seemed to prove most effective in the above direction was the forming of tees and ells with eccentric branches so disposed as to insure complete drainage or otherwise facilitate flow through the mains. Where this purpose would be very difficult of accomplishment with ca-t

or forged fittings, it is simplicity itself when welding sections of pipe together to form fittings. A pipe branch can be welded on to the main at either the upper or lower edge, or be welded so as to point in any conceivable direction; the flexibility of combinations thus available by the use of the cutting torch and then welding in position, is such as to lead to almost limitless arrangements of connections. It has been found that the oxyacetylene cutting and welding torches, if put at the disposal of a steam fitter experienced and seasoned in pipe welding, will be capable of effecting not only a much more economical pipe installation, but one that is more efficient, drains more readily, and will be free from pockets and air binding.

Welded construction was first used for comparatively low-pressure pipe work, including exhaust systems, vacuum lines, and other construction where tightness rather than strength was the prime requisite. The advance toward welding of higher pressure lines has undoubtedly been the result of the success and complete dependability of such low-pressure lines; and at the present time there appears to be no hesitancy in welding piping systems for any pressure whatsoever, provided special precautions, including the annealing of welds, are adhered to for pressures in excess of 300 lb. per sq. in. Such welded construction has now developed to the point where well-equipped piping concerns are prepared to weld with either butt or cupped joints in regular line-piping work, and fabricate branches, tees, ells, reducers, and other special fittings. It is customary to subject such piping connections to hydrostatic pressure tests of approximately the following ratios:

| | | | | | | |
|---|---|---|---|---|---|---|
| Working Pressure, lb. per sq. in.... | 150 | 300 | 400 | 600 | 900 | 1,350 |
| Hydrostatic Test, lb. per sq. in.... | 400 | 750 | 1,000 | 1,500 | 2,000 | 3,000 |

Not until within the past three or four years, however, did the prestige of welding as a working tool in the piping field begin to attract the attention of the Heating and Piping Contractors National Association. This Association, urged by some of its influential members, began a serious investigation of the possibilities of invasion of their field by this form of construction, a committee of experienced piping men weighing the arguments for and against it. There was strong opposition voiced against this practice from some quarters, it being argued that to accept welding would disrupt a long established industry in the manufacture and distribution of threaded and flanged fittings. On the other hand, there were others who argued and demonstrated the fact that the industry cannot afford to ignore a new economic development in order to foster an old institution, no matter how greatly honored or revered. In addition, a number of the largest piping erectors in the United States, some of whom were also large manufacturers of threaded and flanged fittings, were demonstrating daily in large installation work, the economies in time as well as improved workmanship resulting from the complete welding of piping, even to the almost entire elimination of fittings.

The Heating and Piping Contractors National Association has a special committee at work on the problem of welded piping construction. Through its efforts, an exhaustive study has been made of this practice as it is found under varying conditions in both power-plant and industrial uses, with the result that a manual of standards for welded piping construction is being prepared. This publication will, it is thought, do much to develop safe and satisfactory practices, and standardize them throughout the nation. The scope of this commendable activity is broad enough to cover all classes of piping construction, and for all working pressures from the low-pressure groups up to pressures as high as 250 lb. per sq. in.

### Cutting and Welding Torches Work Together for Economy

It is perhaps in this phase of the development problem that oxyacetylene welding has its greatest opportunity. The training of steam fitters to operate on both cutting and welding is a direct approach to business in this field, and should not be overlooked. A piping contractor recently advised the writer that an oxyacetylene cutting outfit is necessary on the job at the outset in order to cut the pipes to length, make structural changes, etc. It is merely a step further to use the same agency for joining the pipes, instead of the laborious operation of transporting to and from a threading machine and then providing the fittings besides. This is a point on which some very effective missionary work can well be done, by bringing to the attention of the contractors the possibilities of such use of their equipment with greatly enhanced speed and economy on their installation work.

As previously stated, power and heating piping systems have so far been subject to very little restriction of a legal nature. In fact, there are no restrictions on piping in most of the states and municipalities in which effective boiler regulations are in force. The State of Michigan has been somewhat of a pioneer in this respect, having formulated in 1925 a set of regulations and code for the welding of steam piping. This code is administered under the Michigan Department of Labor and Industry.

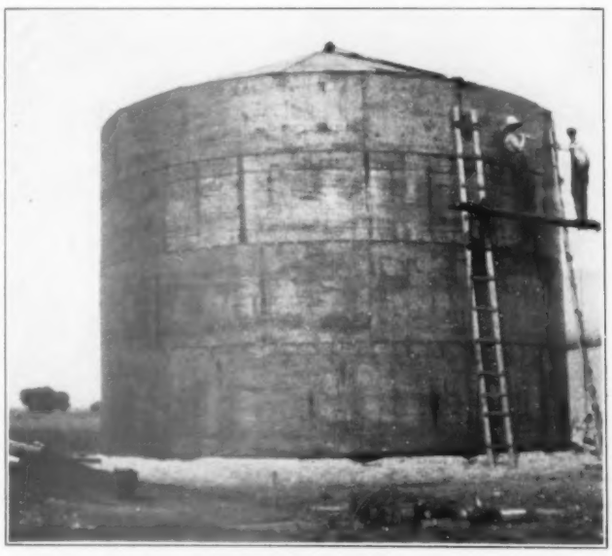
In Ohio, the Industrial Commission is now in the process of formulating a complete code for piping systems, including steam, hydraulic, pneumatic, and refrigerating piping, for all of which definite and practical provisions for welding have been included. This code is still in the formulative state, and will probably not be completed and made effective until after January 1, 1930. If this new piping code in Ohio is administered with the same degree of efficiency as its steam boiler rules, it will undoubtedly work out satisfactorily.

As regards Canada, it is the writer's understanding that both Ontario and British Columbia require inspection of piping systems, and that in both these localities welded piping is provided for. At present neither of these localities has established definite codes covering piping construction, but each depends in a general way upon results of hydrostatic tests. Such inspection work is handled by the Boiler Inspection Department in both Provinces, and appears to be very satisfactorily administered.

---

## ALL-WELDED FUEL-OIL TANK

The illustration is that of a 105,000-gal. tank for fuel-oil storage, erected by the Stover Steel Tank & Mfg. Co., Freeport,



**105,000-Gal. Welded Tank Being Completed.**

Ill., for the J. H. Patterson Co., Rockford, Ill., in June, 1929. This tank, all the seams of which are welded, is 30 ft. in diameter and 20 ft. high. The bottom is of ¼-in. plate, the shell of ⅜-in., and the top of ⅛-in. sheet.

## FLIER RELIES ON OXYGEN GAS TO MAKE ALTITUDE RECORD

At very high altitudes, because of the rarity of the atmosphere, the aviator in flight takes in considerably less oxygen into his lungs than when he is close to the ground, where the air is denser. As oxygen is the life-giving part of the air we breathe, it becomes necessary at high altitudes to provide a source of oxygen for breathing independent of the air itself.

The illustration shows Lt. Willfred G. Moore standing beside the plane with which he established a new United States altitude record for Class C planes on last October 25th, at which time he reached the elevation of 19,659 ft., flying from the Kansas City airport at Kansas City, Mo. The two small cylinders of oxygen with which he was equipped on the flight are shown on the ground beside him.

Connected to the oxygen cylinders was a Victor No. V-50 Oxygen Safety Regulator. The hose leading from this regulator terminated in a small rubber mouth piece held in the pilot's mouth

**Lieut. Moore With Oxygen Tanks Used in Record Flight.**

by two bands fitted loosely around his head. This is a stock regulator, the same as those "Victor" regulators sold to the welding as well as the medicinal trade. Lt. Moore reported that there was not the slightest interruption in the flow of the oxygen, even at the highest altitude reached, nor did the pressure vary during the entire flight.

The oxygen was furnished by the Kansas City Oxygen Gas Co. and was of the same standard medical purity as that supplied by this company to hospitals.

## BOOK REVIEW

ELECTRIC ARC WELDING AND ITS APPLICATION, by Maurice LeBrun, with a preface by Leon Guillet; 252 pages, 5½x8¼ in.; 212 illustrations. Price 20 francs. Published by L'Office Central, De L'Acetylene et De La Soudure Autogene, 104, Boulevard De Clichy, Paris.

After a presentation of the necessary and sufficient facts concerning electricity to enable one to set up an electric arc welding outfit and put it into operation, the author makes a study of electric arc welding and cutting of metals including the generalities on the electric arc, controlling and testing the welds, electrodes and their characteristics, description of materials used for electric arc welding, applications of electric arc welding, and an appendix containing numerous photographs of various jobs.

In the preface of the work Mr. Leon Guillet expresses himself as follows: "All our industries will be grateful to Mr. LeBrun for having devoted this volume to an interesting question of which he has admirable knowledge and for having permitted them to better appreciate a process which is making progress every day."

## ARC WELDING BATTERED RAIL JOINTS

Failures in welded rail joints are generally caused by not following the proper procedure. E. J. Shuler, writing in the December issue of *The Fusion News*, published by the Fusion Welding Corp., Chicago, classifies such failures as follows: (1) Breaks through the rail, starting in the weld. (2) Cupping at the junction of the weld with the parent metal of the rail or just beyond this point back along the rail. (3) Failure of the deposited metal.

Analyzing the causes of these failures, Mr. Shuler states that the first one—rail break—is most frequent when the weld deposit is ended on the rail side at right angles to the edge of the rail. The beads of metals are started at the end of the rail and worked back parallel to the edge, feathering out in thickness. As the bead is finished the arc is broken, and more often than not a crater remains. Shrinkage strains caused by the cooling of the relatively hard metals thus deposited produce a fine network of microscopic cracks. As wheel after wheel passes over this zone, the little cracks begin to connect up, soon becoming continuous clear across the rail ball, and then the crack thus formed grows deeper and deeper until the rail finally breaks, this phenomenon of an enlarging crack in metal being a familiar one.

Cupping between the weld deposit and the rail proper, which is the second type of failure mentioned, is of most frequent occurrence in connection with reclaiming worn rail ends. Here again, ending the weld deposits at right angles to the edge of the rail is one cause of this phenomenon. Owing to the weld deposit being a little harder or softer than the rail itself, however small this difference may be, results finally in the developing of slight depressions on either side of the junction line. The dropping of the wheels into these depressions gradually enlarges them, so that soon every passing wheel gives the rail at these points a severe hammer blow, shortly producing a decided cup.

The third type of failure is the result of the metal being too soft, resulting in rapid wear, or too brittle, resulting in spalling of the surface. The deposited metal is work hardened by the action of the car wheels rolling over it. If the metal originally lacked the proper ductility, such work hardening may cause it to become so brittle that it soon spalls off. Sometimes large chunks of the deposit metal spall off from the rail proper after the first few wheels have passed over it.

None of these failures can be wholly eliminated unless, first, the proper method of applying the deposit metal is employed and, second, the correct welding rod is used.

The correct procedure for welding rail ends, says Mr. Shuler, is to lay a straight edge on the ball of the rail to determine how far back from the end of the rail the deposit must extend. Indicate the extremes of this zone by means of chalk marks. Then draw diagonals from these extremes at the gage-line side of the rail back from the ends in both directions, crossing the ball of the rail to the outer edge. The area between these diagonals is that which the weld deposit eventually is to cover.

It is best to start welding with a mild-steel electrode, running a single narrow bead along the chalk line. This bead should start at the outer edge of the rail and follow the diagonal line

across the ball of the rail, then along the gage line and again across the ball of the rail, following the other diagonal. The advantage of ending the feather edge of the weld in a diagonal line lies in the fact that as a wheel rolls along the rail its line of contact with the rail coincides with this feather edge at only one point instead of at all points as is the case when the weld is ended at right angles to the edge of the rail. Hence the action of the wheels does not induce the small, microscopic cracks in the ending craters to connect up.

There are several advantages in laying this preliminary bead with mild steel instead of the harder material used for building up the rail itself, states Mr. Shuler. If before the work is finished, a train passes and grinds the deposit metal to a level surface, the mild-steel bead will mash out, protecting the wheels and rail. Furthermore, the beads of harder metal can each be finished in this mild-steel boundary bead. The mild steel dilutes the high-carbon or alloy steel and there is much less tendency for microscopic cracks to form during cooling.

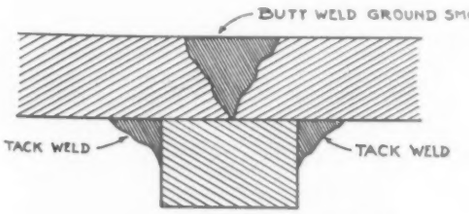
After the boundary bead has been laid down, the proper electrode for building up the worn end should then be used for making the remainder of the deposit. The work should be done with a series of beads laid parallel with the edges of the rail, all starting at the end of the rail and ending in the mild-steel boundary bead. A welding rod should be used that gives a somewhat harder deposit than the metal of the rail itself, and yet not so hard that it will eventually become a hump in the rail.

Sufficient current must be used to give adequate penetration as the beads are laid down, otherwise the entire deposit may scale off. The beads should be laid close enough together that they overlap and present as smooth a surface as possible to obtain. This also calls for adequate penetration, because the beads must not only be welded to the ball of the rail but to each other. The smoother the surface of the deposit, the less metal is it necessary to leave for grinding.

## YACHT CONSTRUCTED BY WELDING

With the phenomenal growth of yachting on the Pacific Coast, a demand for a more modern type of construction embodying a higher degree of safety and better lines has brought forward a new type of construction in the form of the all-steel welded hull, the first of which is now under construction and will shortly make its appearance, states D. Liamin, naval architect, in the November issue of *Fusion Facts*, published by the Stoody Company, Whittier, Calif.

It has been generally understood that steel boats, although stronger and safer than wooden craft, are much more expensive. This is true where riveted construction is used. However, a new type of steel yacht now under construction at the yards of the Standard Steel Shipbuilding Corp. at Los Angeles will cost not to exceed that of a comparative wooden yacht. This yacht will embody many novel features, such a total absence of rivets and bolts, water-tight integral bulk heads, and double bottoms for fuel-oil storage.




**Details of Welded Yacht Joint.**

To insure all the necessary elements of correct welding and to eliminate the dangers of faulty welding, this new type of yacht has frame and plating joints designed to provide strength at these points exceeding the strength of the shell plates themselves. A typical joint of the type used is illustrated.

The construction method, explains Mr. Liamin, consists of the building of a frame work consisting of a plurality of transverse and longitudinal frames arranged to form a plurality of cell spaces. The steel sheets are pressed against the frame work so that their edges engage the frames defining the cells, the area of the plates being such that their deflection resulting from cold bending does not exceed the contractional limit of the elasticity of the metal.

The absence of caulking and the elimination of punching, riveting, etc. not only save time and labor but result in a water-tight hull with interior stresses all balanced, which is impossible in riveted hulls.

The new craft now under construction is 65 ft. long over all, and 13 ft. 6 in. beam. Elimination of fire hazard, greatly increased structural sturdiness, and stability make this yacht the last work in "sea safety", which has heretofore acted as a deterrent to many who would otherwise have been boat owners long ago.

While this vessel is a yacht, concludes Mr. Liamin, the construction is adaptable to every type of work boat, being particularly favored by the oil handlers, as the construction eliminates the leakage of water, which is a source of considerable trouble in the usual tanker.

## PLANS COMPLETE FOR SECOND WELDING CONFERENCE AT IOWA STATE

A preliminary draft of the program of the Second Annual Welding Conference to be held at Iowa State College, Ames, Iowa, January 22nd to 24th, indicates that the scope of the discussions will be very complete as far as the requirements of welders in that section is concerned. Following is a list of the well selected papers which have been announced:

Application of Oxy-acetylene Welding to Industry, by a representative of the Air Reduction Sales Co.

Some Recent Developments in Arc Welding, K. L. Hansen, Northwestern Mfg. Co.

Arc Welding in the Building and Repairing of Farm Implements, John Van Horne, Lincoln Electric Co.

Gas Welding and Cutting of Structural Steel, by a representative of the Linde Air Products Co.

Arc Welding in Steel Construction and Manufacturing Plants, D. H. Deyoe, General Electric Co.

Hard Facing Wearing Surfaces, L. R. Lerch, Haynes Stellite Co.

The Business Side of Welding, H. S. Card, Editor, The Welding Engineer.

Welding Aluminum and Aluminum Alloys, W. M. Dunlap, Aluminum Co. of America.

A Study of the Flow of Welding Metal, A. G. Giles, Joseph T. Ryerson & Co., Inc.

Structural Welding Opportunities in the Repair Shop, by a representative of the Westinghouse Elec. & Mfg. Co.

Methods of Testing Welds in the Small Shop, S. C. Clark, Linde Air Products Co.

Copper and Bronze in the Welding Shop, W. C. Swift, American Brass Co.

Motion Picture—Domestic and Industrial Pipe Welding by the Oxy-Acetylene Process, Linde Air Products Co.

Oxygen Demonstration, by a representative of the Air Reduction Sales Co.

What Happens to the Electrode Material Going Through the Arc, Alexander Chruchward, Wilson Welder Co.

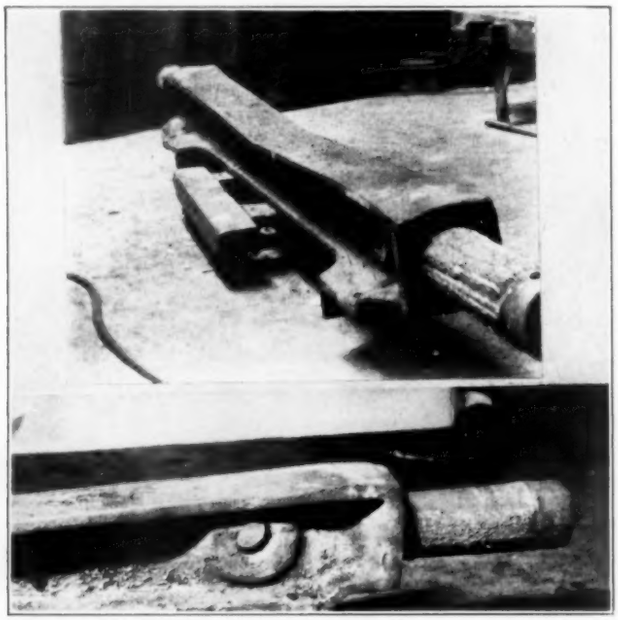
Registration will be at Room 103 in the Engineering Hall, Lectures and Discussions in Room 207, and Demonstrations will be held in the Automobile Laboratory. Skilled operators will demonstrate all of the processes discussed on the program, and individual problems will be given special attention.

# Hints for the Welder

*WHEN YOU FIND a new way to do a hard job, or finish a particularly interesting weld, can you describe how the work was done? . . . . . Have you learned some little stunt every welder ought to know? . . . . . Write to us about these things . . . . . This department helps you welders to help each other. Write up your ideas any old way and just make rough pencil sketches . . . . We'll fix them up for publication.*

## BUILDING UP THE WORN AXLE

Among the numerous interesting jobs recently handled by Anchor Welding Service, Inc., of Chicago, Ill., was the building up of the worn surfaces on each end of a heavy steel axle. The axle, which had formed part of an excavating machine, had apparently been subjected to long and rough usage. The bearing surfaces had worn out of round from ⅛ in. to ⅜ in. in



**Axle Bearings Built Up by Welding.**

depth. Naturally the wheels had become quite loose, making it difficult to move the machine over soft or rough ground.

The axle was taken out of the machine and sent to the welding shop with instructions to restore the original circumference of the two ends. As the photographs show, the welder set to work with the electric arc to build up the required amount of metal. The upper view shows the entire axle with the near end almost completely built up. The lower view shows the other end with only a few beads of metal deposited, and indicates the extent to which the axle had been worn down. Of course, extra metal was added all around so that when the job was machined there would be no hollow spots.

## PROFIT MADE BY OLD WELDER PAYS FOR A NEW ONE

The experience of one welding concern has been that a good-sized business can be built up with only a small cash outlay and a determination to "plug." The man who built up this business bought a transformer-type welder two years ago for $250, from the Goodman Electric Machinery Co., Newark, N. J. With this machine the owner of the new welding shop built up a paying business. Recently he came back to the Goodman company and told them he wanted a modern motor-generator type of welder, as his old welder was out of date and with a modern machine he could increase his production and do better work. The company took in the old welder as part payment on the new, and now the shop owner has an up-to-date machine that was paid for out of the profits on a business entailing only a small investment. And he anticipates that the new machine will increase his profits still further.

## POINTERS ON GOOD ARC WELDING

**By Walter R. Brewer**

One of the first things to consider in the application of arc welding is the question, Is this a job for arc welding? If it is, then we must select the proper materials and methods.

There are two standard rods for arc welding—the 6-point and the 18-point rod. Then there is also the 3-point rod, which I heartily favor for boiler work. For reasonably hard-surfaced welds, use the 18-point rod. All this applies only where d-c. machines are used.

For boiler work and most structural-steel jobs, I do not like a heavily fluxed rod, but one with a light, volatile flux.

For welds that must withstand tension and vibration stresses, nothing is better than a light-fluxed 6-point rod that is clean and as free as possible from dross. This rod has several advantages. In the first place, it does not burn easily on account of the absence of carbon. Also, the weld, when it has cooled, will not be brittle and its tensile strength will be high. The welder will notice quite a difference in the absence of black oxide in the weld.

After the proper rod has been chosen, the preparation of the weld should be given consideration. Good Mother Wit must be used in designing it. If it is to be V'd, use the cutting torch and clean all oxidized metal from the weld by a chisel or grinder; then chipping and roughing will be unnecessary.

Regarding the size of the V, nothing is gained by making the V wider than necessary to allow the operator the free use of the rod in all necessary positions. I do not mean, however, that the sides should be left parallel, since in that case the operator could not get the correct angles on the sides with the electrode. If the V is too wide, the operator must make an undue amount of fill, and the casting will become more or less burned as he runs and re-runs over the weld; but if the V is not too large, new metal from the work is caused continually to flow into the weld and mix with the electrode metal, resulting in a strong deposit.

A good weld is characterized by full penetration, notwithstanding that by penetrating way down into the parent metal we not only burn some of the carbon that is in the steel,

but we make a porous, hard, and brittle casting of the deposit, resulting in a coarse-grained weld.

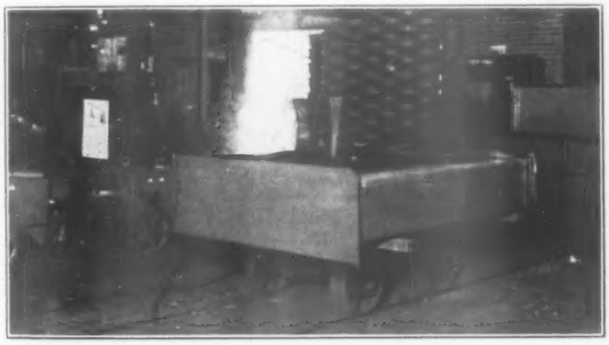
Penetration depends on time and heat. If you use a medium heat, moving the electrode slowly, puddling and building up as you proceed, and employing a short arc, the grain of the metal will be greatly improved, as well as the penetration, and less heat will be imparted to the parent metal, resulting in a weld of high quality. Moreover, less slag will manifest itself. Also, the casting you are depositing will be characterized by a nice grain and color. This procedure is as simple to apply overhead as flat, only a little more heat will be required because of the length of the arc that is necessary. The operator should not cut the amperage so low that he fails to get penetration, but, on the other hand, he should not employ an arc hot enough to burn the weld. The operator at all times should use care in holding the correct angles of the electrode.

Too much stress cannot be laid on the importance of cleaning the weld as you advance with the work. With the hammer, chisel, and brush, keep all oxides (scale) removed, and keep the metal so it has the desired blue color. If the operator follows these directions, a good weld is bound to result.

## TWO WELDING SETS FABRICATE TRUCK DUMP BODIES AND DO ODD REPAIR JOBS

By W. K. W. Hansen, Works Manager,
Hockensmith Wheel & Mine Car Co., Penn, Pa.

The manufacture of a line of truck dump bodies was recently taken on by the Hockensmith Wheel & Mine Car Co., Penn, Pa. Fabrication by arc welding seemed the modern and the



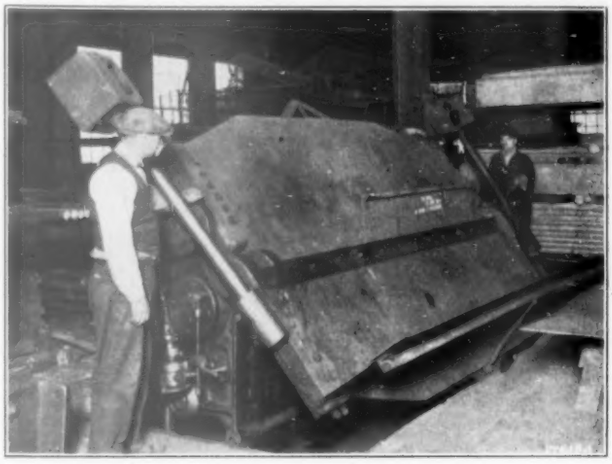
**Truck Dump Body Welded by One of the Arc Welding Sets Shown in the Background.**

logical method of construction to employ. Two Westinghouse 200-amp. portable welding sets were installed. As a result, these two machines daily have been paying dividends, serving the main production line as well as the maintenance jobs of the shops.

**A Group of All-Welded Truck Dump Bodies.**

The two welding sets are located at the end of a production line that has proved to be very efficient and flexible. The sheet-steel plates for the dump bodies are sheared to pattern size and are then bent to form the desired member. The parts are clamped and braced for fabrication.

With two operators working, the two machines turn out an average of five dump bodies a day, which is considered good.



**This Machine Shears and Bends the Body Parts to the Desired Form.**

The product is of uniform and rigid construction and of neat appearance. By this method of fabricating, these dump bodies are of maximum strength and minimum weight.

The welding equipment has also been put to a wide variety of uses around the shops, outside the general run of production. As examples of its usefulness in maintenance work, it has been used to repair a broken pulley, a cracked cylinder head in one of the company's trucks, and a broken bearing cap on the shop crane. Also, numerous shop fixtures have been built by arc-welded fabrication.

## WELDING SPEED INCREASED BY USING THE "WHIP" TECHNIQUE

The welding speeds attainable by the use of a new method of handling the electrode, known as the "whip" technique, are startling to those who are not familiar with the matter, states Arthur Bernard, in the December issue of *The Fusion News*, published by the Fusion Welding Corp., Chicago. In leading up to a description of the "whip" technique, Mr. Bernard discusses the theory of electrode melting rate, including chemical and physical control of the rate of deposition of electrode metal.

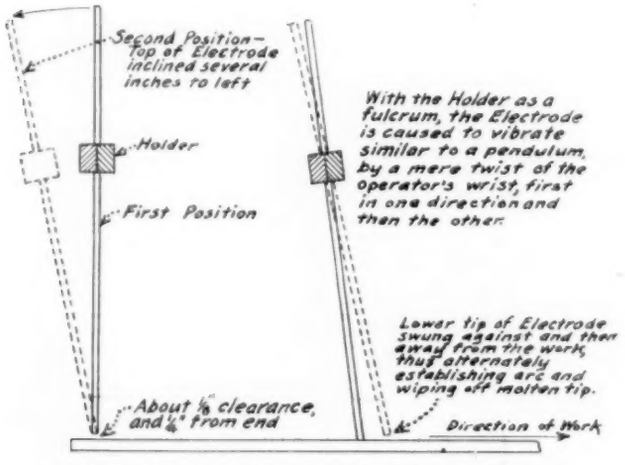
All attempts to control the melting rate of electrodes should be based on the theory that the larger the molten drop on the electrode tip, the less is the rate of melting, for the zone between the molten and solid metal is farther away from the heat of the arc. The problem then resolves itself into one of detaching quickly the molten film from the electrode tip before it forms into a large drop of molten metal.

Any violent chemical action taking place at the neck of the drop where it hangs onto the hot solid metal will trend to blow the drop off. The molten tip of a steel electrode that is chemically clean will combine rapidly with the oxygen and nitrogen of the air, causing the drops to be blown off more rapidly than when materials are present on the electrode surface to protect the neck of the drop from contact with the air. This method of gaining speed, however, is always at the expense of arc stability, the poor operating characteristics tending to produce a low-quality weld. The interested experimenter may illustrate the principle involved by taking a bare mild-steel electrode and polishing off several thousandths of an inch in a centerless grinder. The rod will be found

unpolished and coated with thorium oxide to about the thickness of the usual commercial white flux coating, will be found to flow quite rapidly with an erratic arc. The same rod, to melt very slowly, each drop often requiring several seconds to form.

Physical control of the melting rate, which is the next general method discussed by Mr. Bernard, involves control of the surface tension of the molten metal of the drop at its neck. The arc heat is thus concentrated in a ring around the neck of the molten drop, hence reducing the surface tension at this point to such a degree that the forces of gravity or capillary attraction of the molten deposit metal are the greater, and the drop is detached. This method, however, requires much knowledge of electrode design and scientific experience to be successful. It can be illustrated by coating a mild-steel electrode with beryllium oxide, although this is not a commercial method. A sheath-type arc will result, but at the same time several characteristics detrimental to a good weld will be introduced. Moreover, the cost of beryllium oxide, which is used to form the sheath-type arc necessary to this method, is prohibitive from a commercial standpoint.

Mechanical control, which is the third general method discussed, differs from the two types of control already described in that any experienced arc welder can apply it, states Mr. Bernard. This method involves wiping the drops as they just


Second Position—top of Electrode inclined several inches to left
Holder
First Position
With the Holder as a fulcrum, the Electrode is caused to vibrate similar to a pendulum, by a mere twist of the operator's wrist, first in one direction and then the other.
Lower tip of Electrode swung against and then away from the work, thus alternately establishing arc and wiping off molten tip.
About 1/8" clearance, and 1/4" from end
Direction of Work

**Illustrating the "Whip" Technic of Arc Welding.**

begin to form and are still quite small, by the operator's mechanical manipulation of the electrode. It seems that the easiest way for accomplishing this is by the method known as the "whip" technique.

Consider that two bars or strips are to be welded and are laid on a table in front of the operator in such a way that the seam to be welded runs from the operator's left to right as he stands facing the table. The electrode is held preferably at right angles to the axis of the holder, which is gripped in the right hand. The electrode is held over the left extremity of the seam to be welded, extending straight up from the surface of the work. Still holding it in this upright position with its end out of contact with the work by an eighth of an inch or a little more, the operator moves it to the right approximately one-quarter of an inch. The upper end of the electrode is then inclined several inches to the left, care being taken that it does not move either toward or from the operator and that the lower end remains in the position described. This position is the one to be assumed preparatory to striking the arc. The arc is then struck by twisting the wrist in such a way that the electrode swings down towards the work as if it were a pendulum held in position by a pivot at the top. In this manner, the lower end of the electrode moves in the arc of a circle which intercepts the surface of the work.

The instant that the arc is struck, the lower end of the electrode should be swung upward to the right by twisting the wrist in the reverse direction. The arc is drawn out, a small quantity of metal is fused on the end of the electrode, and immediately the movement is repeated by twisting the wrist in such a manner that the lower end of the electrode is moved down into the molten deposit metal, wiping off the forming drop, and then immediately moved away, upward and to the right, thus reestablishing the arc.

The swinging, pendulum-like motion of the electrode is accomplished entirely by the wrist movement. As the seam fills up with deposit metal, the entire arm or body moves along to the right. Although some practice is required to acquire this technique, after it has once been mastered it is fully as easy and natural as the ordinary method, wherein the electrode is held steady excepting for its movement forward as welding proceeds.

Operators may find it more satisfactory to start welding a seam in the ordinary fashion with the electrode held steady for a moment and then change to the swinging motion.

The increased rate of welding attained by the "whip" technique requires an increased current over that ordinarily used if full penetration is to be acquired, which is evident when one considers that the current alone makes the heat and as more metal is to be melted in the same length of time naturally more current must be used. The increased current also results in the need for a greater size of electrode; otherwise the electrode would tend to become red hot. Moreover, at very high speeds of welding, insufficient metal is deposited from a small rod to make the proper size of bead.

It is important, when first introducing the "whip" technique, to make preliminary welds and examine them very carefully for penetration, cautions Mr. Bernard. The current and the speed of welding must be brought into such balance that adequate penetration is assured. Different types of electrodes themselves give different degrees of penetration, and that type should be selected which best balances out with the new conditions introduced by employing the "whip" technique.

It is important to swing the electrode at just the right rate, which will differ according to the current, welding speed, electrode size, thickness of the work, and other factors. It is also important that the flame leave the arc stream in the direction in which the welding proceeds and plays on the edges to be welded ahead of the arc, thus preheating them.

## NO MYSTERY ABOUT ARC WELDING

**By John Van Horn**

The fundamental laws governing the melting and working of steel hold good in the process known as arc welding.

When an electric current jumps from one point to another, a very high degree of heat is generated at each end of the arc. This heat is so great that it not only melts but vaporizes the steel. The application of this knowledge requires the observance of a few fundamental laws.

We can melt and vaporize steel by causing electricity to arc between two terminals of that material. By using a mild-steel wire of, say, $\frac{3}{16}$ in. diameter as one terminal and a substantial block of steel as the other, and starting the flow of electricity by touching the end of the wire against the steel block and quickly withdrawing it so as to leave a gap of about $\frac{1}{8}$ in., we find that the flame of the arc not only melts a spot on the steel block but melts the end of the wire with so explosive a force that the molten and vaporized metal is projected across the $\frac{1}{8}$-in. space and impinges against, and amalgamates with, the molten metal of the steel block. Now we move the wire toward the block as fast as it is fed into the weld; this is called "laying the bead." The metal in the weld is composed of the wire metal mixed with a part of the block that was in liquid state during the operation.

together with whatever gases were absorbed during the operation and not expelled before the metal solidified.

It follows that the best welds are made by exposing the least amount of liquid metal to the air. Hence, use as large an electrode as can be handled satisfactorily. Keep the arc gap as short as possible, and in some cases surround the arc with an envelope of harmless gases, such as hydrogen, for example.

A material that promises to be of immense value to welding is the heavily coated electrode. In use, this coating, which is non-metallic, extends beyond the active end of the metal, and, in fact, usually touches the surface of the molten metal of the weld. The effect is to confine the flow of metal across the arc and blanket it from contact with the air. This results in faster welding and a higher grade of metal in the weld.

The weld, of course, is cast steel—steel that has been melted and cooled to a solid state but has not been worked on or forged.

It requires some skill to manipulate the electrode properly in making a weld, but probably no more native ability than that necessary to learn to wipe a lead pipe joint. It also calls for the exercise of judgment to take care of strains set up by shrinkage when the weld metal cools.

It requires a working knowledge of the metals to be welded: that is, how they behave when mixed and subjected to the intense heat of the arc. For instance, when cast iron, with its excess of carbon, is melted and mixed with steel, it cools into a very high-carbon steel very similar to malleable-iron stock before annealing. This is glass hard and brittle. Some of the essential parts of brass are vaporized and lost by arc welding. Lead would be consumed by the intense heat of the arc. Aluminum, too, is usually destroyed by the arc. All these facts are common engineering knowledge, and we need only apply them to arc welding as we would to work done in any other way.

There is no mystery about any of it. Like many other crafts, arc welding, when new, was made as mysterious as possible by some who were fortunate enough to get into it. Electricity, used to generate the heat, helped to cover the art with a mysterious shroud. Even the self-styled High Priest might not know the difference beween a kilowatt and a shunt field, but he could look wise and cover up a lot of ignorance by talk that sounded deep.

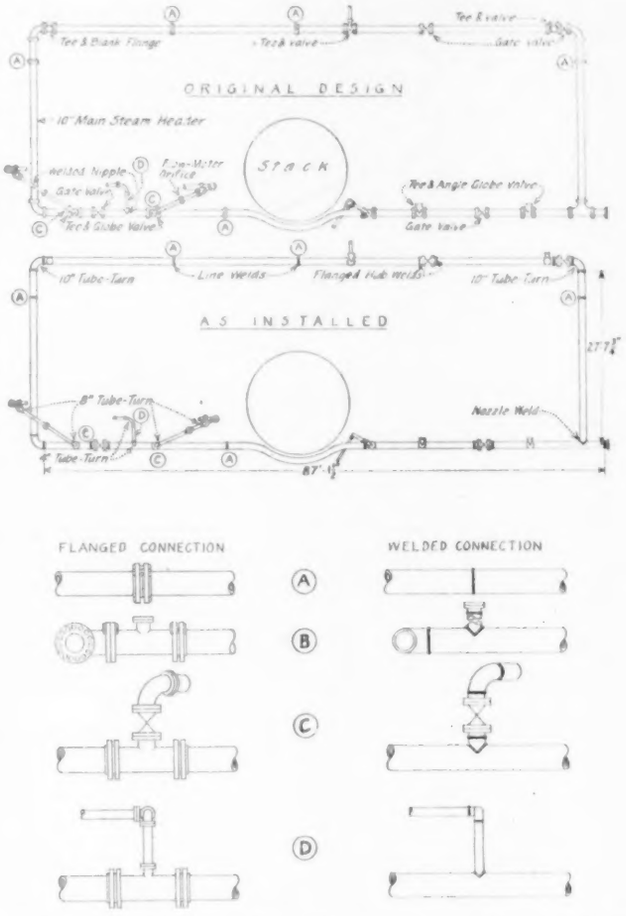
## REDESIGNING A PIPING SYSTEM

When the U. S. Bureau of Standards was recently confronted with the problem of how most economically to supply heat and power to their several new buildings, it was decided to bring the power plants together, as one unit, into one building. The boiler-header piping for this central plant was originally designed to use cast steel fittings. Because of the economies and other advantages of welding, however, it was finally determined to install an all-welded system, so far as requirements would permit, making use of Tube-Turns, which are short-radius seamless drawn fittings. The installation was made by the Heat & Power Corp., of Baltimore, Md.

Modern in every respect, the present new power plant is designed to operate at 250 lb. pressure and 100 deg. F. superheat. The diagrams show the original layout with flanged fittings, as well as the redesigned layout employing welded joints and Tube-Turns. Some of the connections employed, indicated by the letters A, B, C, and D, are shown in detail below the layouts. Here the simplicity of the welded construction is fully brought out. The only open joints in the actual installation are at the valves or where flange unions were installed to accommodate the testing apparatus.

The trend toward increasing temperatures and pressures in power plants has created new problems in the design and fabrication of steam piping. Chief among these are, how to secure permanently tight joints, how to minimize transmission losses, how to maintain factors of safety, and to provide for increased expansion and contraction, and how to adhere to economical design.

In the new Bureau of Standards plant, these problems have been successfully met by making the joints permanently tight by welding and by using Tube-Turns for bends, these fittings having a strength and a coefficient of expansion equal to that of the pipe with which they are used. Also, they are made of the same material as the pipe and are not subject to leaks caused by blow holes or porosity. The contractors on the plant state that the use of Tube-Turns enabled them to secure a proper distribution of expansion and contraction, resulting in a




**Comparison of Flanged and Welded Designs for Same System of Piping.**

reduction in the cost of anchor and hanger supports, saving in cost of materials, and a substantial reduction in the pipe-covering cost, since there were no flanges to be covered.

The combination of welded joints and seamless drawn fittings is an ideal one for piping installations, and is bound to be used more and more in design as its advantages become known.

## WELDING COST AND WIRE COST

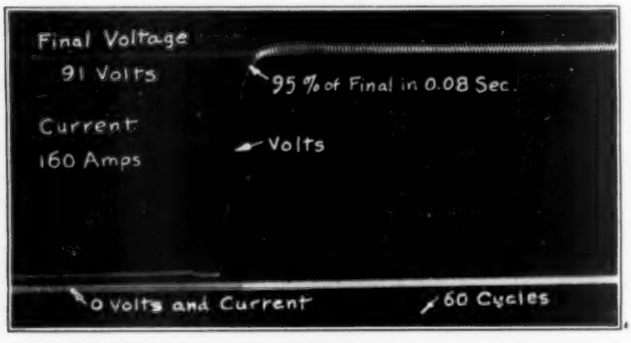
In discussions of the economic side of welding the point is often made that cost figures should not be isolated so that the cost of any one item would be considered independently of its effects on the corresponding cost of other items in the same job. In a letter recently mailed by the John A. Roebling's Sons Company, this point is illustrated by taking one welding operation as an example. The job consisted of repairing the boom support of a steam shovel. This was a steel casting of which the replacement cost would be $1,500. The labor cost of the repair was $72, and the job required 40 lb. of Roebling's low carbon electric welding wire at 10c a pound: that is, $4 worth of wire. On a percentage basis, the welding wire cost was 5.26 per cent of the total cost of the job and 5.5 per cent of the cost of the labor. The letter points out that had a lower priced welding wire been used, costing say 1c a pound less, and representing a 10 per cent reduction in the cost of the fire, it would only have represented one-half of

1 per cent of the labor charge. This is a striking example of how an apparent saving may involve the risk of increasing the cost of a job if the saving is made on materials at the possible increased cost of labor, it being well known that wire which is not manufactured especially for welding is subject to erratic working qualities which slow up operations and often result in having to do a job over again.

## MAKING WELDING-MACHINE VOLTAGE MORE RESPONSIVE TO ARC CHANGES

One of the baffling questions in the field of welding is how to decrease the time for voltage recovery in direct-current welding machines. By "time of voltage recovery" is meant the length of time for the welding machine to recover full open-circuit voltage from a state of short circuit. The quicker this recovery, the more nearly will voltage changes in the machine follow the voltage changes of the arc, and the net result is an easier-operating arc, which means more work with less fatigue and effort on the part of the operator.

The Research Laboratories of The Lincoln Electric Co., Cleveland, Ohio, began work on this question in 1924 and, it now appears, have a solution as a commercial possibility in the not too




**Oscillograph of Arc Voltage and Current Obtained on Experimental Machine.**

distant future. In fact, experiments already performed show that this time of recovery can be reduced to a very small fraction of a second.

In all single-operator welding machines now on the market, there must be some method of reducing the open-circuiting voltage of the machine to the varying voltage demanded by the arc. This may be accomplished by utilizing armature reaction, varying the series field, or by any one of a dozen or so other methods. In effect, however, the results are similar—one magnetic field opposes another.

When two magnetic fields are in proximity, there is produced in effect a transformer with the well-known transformer characteristics—that is, if the current in one of the windings is changed, a voltage is immediately set up in the other winding and this other winding will have a current flow in it as a result of the induced voltage.

It is a law of electric circuits that the induced current always flows in such a way as to nullify the magnetic effect of the inducing, or original, current in the first winding. As a result of this action, ordinarily the machine will not adjust itself to the changes in the voltage of the arc as quickly as it could if the internal transformer action were eliminated.

Various devices are being used to overcome the effect of this transformer action in the arc circuit. It is easily appreciated that if the nullification of this transformer effect can be accomplished inside the machine, results would be materially better. Experiments have shown the possibility of inserting in the arc circuit a device that will produce effects similar to those produced in the machine by the transformer action of the double winding on the pole pieces, except that the effect will be in the opposite direction, thus nullifying the original transformer action.

The accompanying oscilograph shows the results where an experimental device, such as that described above, was used. It will be noted that the length of time for the voltage to rise from zero, or short circuit, to 95 per cent of its final voltage is only eight-hundredths of a second in this case, as compared with values heretofore obtained of one-half second and more.

Ordinarily when a welding machine is short circuited, the instaneous short-circuit current will immediately rise to a considerable higher value than desired for the best welding operation. In ordinary welding with the metallic arc, the machine is being short circuited intermittently from perhaps 15 to 30 times per second by globules of molten metal touching both the electrode and the work. These peaks of current occurring at short circuit cause considerable higher heat loss in these molten globules than is desirable, causing the globules to boil or explode. The welding operator calls this "spatter."

By nullification of the transformer effect the overshooting of the current at the time of making a short circuit is reduced and, experiments show, made almost zero.

These results and the deductions drawn are the result of many experiments and a very exhaustive study of arc characteristics conducted over a period of years.

## WESTINGHOUSE SIGN IN CLEVELAND IS ALL WELDED

Considerable newspaper publicity has been given to photographs of the illuminated sign recently installed upon the Cleveland foundry of the Westinghouse Electric & Manufacturing Company. One of the interesting features of its construction is that although it contains 14 tons of steel, not a single bolt or nut was used in fabricating it. Electric welding was employed throughout to make every piece an integral part of the completed structure, capable of withstanding the gales from Lake Erie, which is only a few hundred yards away. Another interesting feature of the sign is a rather unusual safety device. This is a cage ladder used when the electrician cleans or replaces the lamps on the sign. The cage ladder operates on rollers extending the full length

**Partial View of All-Welded Electric Sign.**

of the sign, which is 100 feet, and gives access to every one of the 1,400 lamps which are used for illuminating the twelve-foot letters.

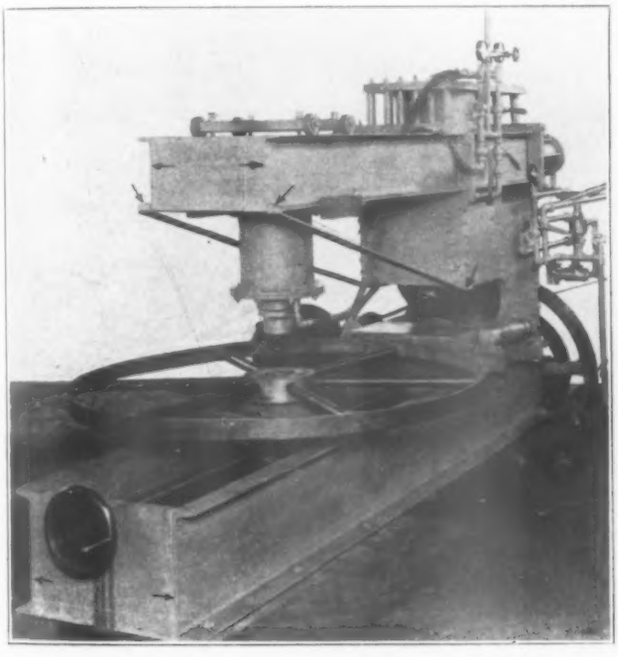
## FLANGING MACHINE IS INTERESTING EXAMPLE OF WELDED DESIGN

The illustration is that of a machine for flanging boiler and tank heads, either flat, bulged, concave, round, or square, and for performing work on special shapes. The simplicity and strength of the construction are largely due to the use of welding. The body is built of steel plate, cut to shape and firmly bolted to-

gether. The two extension members, the upper one of which carries the center hold-down and its air cylinder, and the other the supporting spider, are made of heavy channel sections, the ends being formed of steel plates butt welded to the sections. The upper member is braced by two heavy straps running from the end to the main frame and welded in place. The supporting spider is also of welded construction, the rim consisting of a heavy strip rolled to shape and butt welded. The spokes are of seamless tubing, set in holes drilled in the hub, and welded to the rim. The hub is cut from a steel forging and fits over a pin mounted on a carrier on the lower member, the pin being carried on a Timken thrust bearing.

The flanging mechanism is mounted in the main frame and consists essentially of two working rolls and a spinning roll, all mounted in Timken bearings. The plate to be flanged is placed on the supporting spider, the position of which is adjusted manually by an endless screw which moves the carriage along the guides. The center hold-down is brought into position over the plate, and the plunger forced down by compressed air, thus holding the plate firmly against the spider hub. Starting the motor causes the plate to revolve, and the two working rolls are then brought into position.

The speed of performing the flanging operation is indicated by the fact that a flange 2½ in. deep was rolled on a flat head of



**Welded Flanging Machine, Some of the Welded Joints Being Indicated by the Arrows.**

¾-in. plate, 12 ft. in diameter, in one minute from the time it was set up and started. Flanges are made with no sign of distortion or wrinkling in the finished head, it is claimed.

This machine is made in four standard sizes for use on material varying from 24 gage to ¾-in. plate. The overall dimensions of the machine are, roughly, 14 ft. 8 in. long by 6 ft. high, and its weight varies from 3,000 to 6,000 lb. The machine is made by the Blue Valley Machine & Die Works, of Kansas City, Mo.

## PROMINENT ENGINEER BECOMES UNIVERSITY PROFESSOR

Erwin E. Dreese, chief engineer of The Lincoln Electric Company, Cleveland, Ohio, has been appointed professor of Electrical Engineering at the Ohio State University, as part of a program of adding more men of national reputation to the faculty of that institution.

Mr. Dreese is a graduate of the University of Michigan, where he received his electrical engineering degree in 1920. He served in the Signal Corps of the U. S. Army during the war. Although only in his middle thirties, he is nationally known in the field of electrical engineering.

A year after joining The Lincoln Electric Company, where he has been employed for the last five years, he was made chief engineer. In June, 1929, he was recalled to the Uni-

**ERWIN E. DRESSE**

versity of Michigan to receive the professional doctor's degree of electrical engineer, a distinction said to have been conferred only once previously by that institution.

During his teaching career, Prof. Dreese engaged in numerous projects of engineering investigation and research, and since joining The Lincoln Electric Company he has presented numerous papers before engineering societies.

## GAS WELDING OF ILLIUM

**By D. D. DeTrow**

The metallic element illium is being used in our analytical laboratory for the making of calorimeter bombs to be used in determining the heat content of coal samples. It used to be that the best of such bombs were made of platinum, which metal is now replaced with illium, a metal whose characteristics as regards heat and acid resistance are very similar to those of platinum. So far I have had no failures in the acetylene welding of illium, but the methods are so slow and difficult that I am far from satisfied. If any others have attempted to weld this metal, I should like to know the methods used and results.

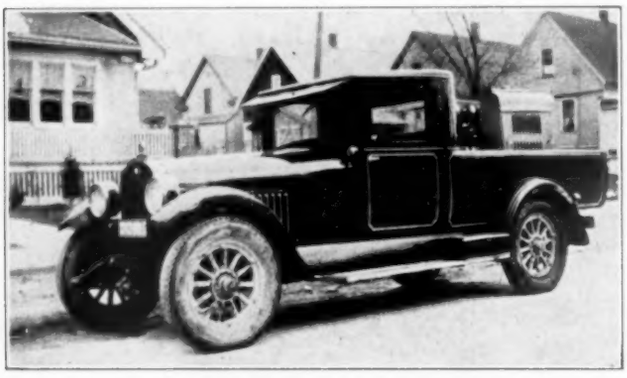
I find that illium is very slow to absorb heat and cannot be hurried. The excess acetylene flame gives best results with a powdered-borax flux. Welds made on electrode posts, which were apparently sound and able to stand bending and looked perfect, failed to pass a 20-volt current of 2 amp. to the fuse wire. This appears in the weld only, and I hope to interest our house electrician in a test to discover the reason therefor.

The flash pans that contain the coal are readily welded and withstand very well the heat that is generated in a calorimeter bomb.

## WELDING SUPPLY FIRM USES SNAPPY DEMONSTRATION OUTFIT

For purposes of demonstration, the Welding Engineering Company, Milwaukee, Wis., uses the outfit shown in the accompanying photograph to good advantage. The transportation unit is a Hudson automobile with a special body arrangement on which is mounted a gasoline engine driven, 200 ampere, Hansen arc welder. From this machine, they are able to run a pair of 300-ft. cables. The outfit is also equipped with oxygen and acetylene cylinders together with 100 ft.

lengths of hose and a complete Meco welding and cutting outfit. The effect is that of a completely equipped welding shop on wheels, and serves the purpose of demonstrating both processes to possible users of equipment. The complete outfit is kept in first-class shape and through its fine appearance



**Milwaukee Supply Firm Demonstrates the Advantages of Welding By Means of This Portable Outfit.**

creates a favorable impression on customers and prospects. Mr. A. H. Friese, president of the concern, states that he is greatly pleased with the success which he has had with it in the Milwaukee district.

## ARC WELDING MANUFACTURERS LAUNCH CO-OPERATIVE CAMPAIGN

Half a dozen manufacturers of electric arc welding machines are sponsors for a series of advertisements now appearing in magazines having a large industrial circulation. The first of these features—the picture of a giant welder with his helmet adjusted and electrode holder ready for action, introducing himself with the words "I Am Arc Welding—A Dominant Figure In Industry." Across the bottom of the advertisement is pictured a steel platform supporting a number of typical industrial plants and bearing the slogan, "My Platform Is Steel. My Creed is Progress." The text of the advertisement gives some of the reasons why arc welding is being adopted as a production process in industry. The advertisement is signed by the General Electric Company, Westinghouse Electric & Mfg. Co., the Lincoln Electric Co., Northwestern Mfg. Co., Una Welding & Bonding Company and the Wilson Welder & Metals Co. It appeared on the inside front cover of the January issue of the Nation's Business and has also been noticed in other magazines in the metal working industries.

## LOTAN COMBINES WITH GAS WELDING SERVICE

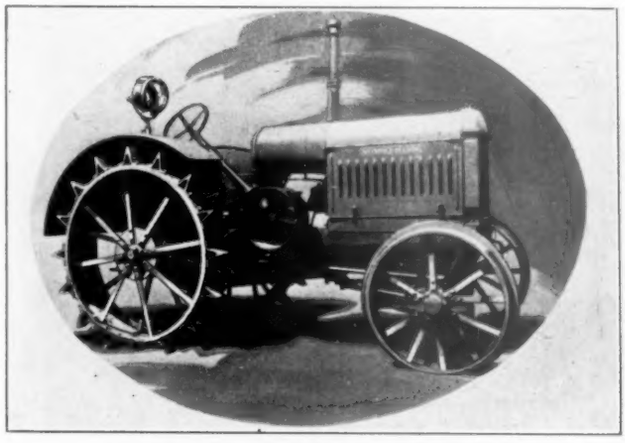
Announcement has been received that The Lotan Products Company has combined with the Gas Welding Service Company of Cleveland, Ohio, forming a new organization known as the Lotan Research Corporation, with headquarters at 6545 Euclid Avenue, Cleveland, Ohio. The Lotan Products Company was organized to manufacture the Lotan line of fluxes, and the Gas Welding Service Company specialized in gas welding apparatus and engineering service. The new corporation offers the combined advantages of a consulting engineering service and a complete line of gas welding products formerly made by the two companies. All Engineering Service will be under the personal direction of Mr. H. R. Williams, former president of Gas Welding Service Co. General Management and Sales Engineering will be capably handled by Mr. Daniel Helmer and Mr. S. C. Harris, both formerly connected with Perfection Stove Co. Mr. Clarence H. Dray is Counsel for the corporation and its Secretary.

## ELECTRIC ARC CUTTING AND WELDING COMPANY EXPANDING

It is reported that the Electric Arc Cutting & Welding Company of Newark, N. J., manufacturers of A-C and D-C arc welding machines and electrodes, have acquired property adjoining their plant at 152 Jelliff Avenue, Newark, N. J., for the purpose of providing additional space to accommodate the Wire Department, both branches of the business having reached the point where present facilities were inadequate to take care of it. Mr. C. J. Holslag, Chief Engineer of the company, writes that they have on hand at the present time a very large assortment of used, traded in and rented machines of a great variety of styles and makes. This company rents machines and allows rental to be applied against the purchase price if the renter decides to keep a machine permanently.

## PREST-O-LITE EXHIBIT AT ROAD SHOW

A full line of Prest-O-Lite truck and tractor lighting equipment and Carbic floodlights are the features in the exhibit of The Prest-O-Lite Co., Inc., in booth 406 at the Road Show, being held at the Atlantic City Auditorium, Atlantic City, N. J.,



**Prest-O-Lite Tractor Lighting Equipment.**

January 11th to 17th. Prest-O-Lite small tank appliances, Oxweld cutting and welding equipment, and the Carbic generator are also on display. The booth is in charge of H. H. Griffith of the New York office of the company.

## STORTS WELDING COMPANY GIVES CUSTOMERS INSTRUCTION SERVICE

There was a time when many capable welding operators hesitated to give instruction to other men for fear of inviting competition in their trade. They preferred to surround their craft with an air of mystery and let people think that it could only be learned by long and tedious training. Welding shop owners were also inclined to discourage plant managers from purchasing welding equipment for maintenance work because they feared that their trade would fall away if the plants were able to handle their own maintenance. The experience of the industry has been that their fears were for the most part groundless, and there are hundreds of prosperous welding shops today doing a splendid volume of business in spite of the fact that many of their customers own their own equipment and have employed skillful welders. In contrast to the old-fashioned idea, the policy of the Storts Welding Company of Meriden, Conn., stands out as a shining example of the modern appreciation of what real service is. This company does a welding repair business and are one of the best known companies in the East manufacturing welded tanks. In addition to this, the company sells welding equipment and for some time has maintained what they designate as "Storts

Welding Instruction and Advisory Service." This has been maintained principally for the benefit of manufacturers for whom they do welding and to whom they sell supplies. When an operator is sent to them for instruction, he is given a twenty-six weeks' reading course during which time he visits the Storts plant one day per week to observe qualified welding operators in action. These operators explain the various types of work and give instructions on the reasons for the methods of handling each operation. This program is followed for six or seven weeks, at which time the students are permitted to weld on some of the production and repair work in the plant. They get some practice instruction during the first six or seven weeks in certain control practices. Most of the material used for the reading course is from *The Welding Encyclopedia*, the General Electric Instructian Manual and the publications of the American Welding Society. Mr. J. D. Tierney, Proprietor of the Storts Welding Company, has prepared a special typewritten form explaining this instruction and advisory service in detail, giving the reasons for establishing it and a complete outline of the method of instruction. In this bulletin, he points out that no manufacturer expects an unskilled workman to perform his duties with the precision of a trained and experienced operator, that the user of welding equipment can get the best value out of it only when he puts it in the hands of men who know how to use it correctly, and that this service has been added to the activities of his company for the purpose of supplying any deficiencies which may be existing in the training of welders in the company of his customers.

## CHANGES IN TAYLOR-WHARTON SALES PERSONNEL

Mr. A. F. Marwick, formerly general sales manager for the Pettibone-Mulliken Co., has joined the Chicago district sales staff of the Taylor-Wharton Iron & Steel Company and William Wharton, Jr., & Company, Inc.

Mr. G. V. Wood, formerly located at the Highbridge plant of the Taylor-Wharton Iron & Steel Company, is now western sales manager for the Taylor-Wharton Iron & Steel and Associated Companies. Mr. Wood's headquarters will be in San Francisco.

Mr. J. R. Van Rensselaer, formerly the sales representative with Taylor-Wharton's San Francisco distributor, is now located at the New York cylinder sales office of William Wharton, Jr., & Company, Inc.

## WESTINGHOUSE TO BUILD HUGE ENGINEERING LABORATORY

An expenditure of $1,500,000 will be made by the Westinghouse Electric & Manufacturing Co. in the construction of a central engineering laboratory and an addition to the present direct-current power laboratory, both in East Pittsburgh, Pa. The new buildings will house generators large enough to supply electricity to a town of 10,000 persons, to be used only for experimental purposes. Artificial lightning for testing purposes will be produced by a high-voltage surge generator. Test circuits of almost any voltage and frequency will be provided for. In the weathering rooms will be produced all kinds of weather in which apparatus for outdoor service will be tested. In another room any given set of atmospheric conditions of temperature, pressure, and humidity can be accurately reproduced.

The new laboratory will eventually replace numerous smaller laboratories and experimental test sections now scattered throughout the plant. Six upper floors will be used for engineering offices. The laboratory will be an 11-story structure, 80 ft. wide and 225 ft. long, adjacent to which will be the 125-ft. extension to the direct-current laboratory.

"Erecting such a complete laboratory for development work in electrical engineering indicates our sound faith in the future of the electrical industry, which has experienced a phenomenal growth during the last ten years," says F. A. Merrick, president of the Westinghouse company.

## NEW WELDIT BILLET SCARFING TORCH HAS MANY USES

A recent addition to the oxy-acetylene apparatus line made by the Weldit Acetylene Company, Detroit, Michigan, is an especially designed cutting torch made primarily for billet scarfing. For this purpose it is equipped with a special head and jet and a special type of tip. It is in use in several mills for scarfing and removing defects from steel billets. In one mill with a Number 1 jet and Number 20 tip working on low carbon basic steel it cut at the rate of 14 ft. per minute. On .65 to .70 carbon, with a Number 29 jet, the cutting was done at the rate of 41 ft. a minute. In another plant one cutter and one helper together averaged 41,000 lbs. in 10 hours using 98.5 cu. ft. of oxygen and 23.6 cu. ft. of acetylene per ton. These figures were obtained on a run of 4"x4"x12" billets over a period of one month, the average speed being between 18 and 24 ft. per minute. It was found that low carbon increases the cost and high carbon decreases the cost of operating.

Another interesting use of this new type of torch has been found in the blowing out of counter sunk rivets. On one job one hundred ⅞" rivets were cut at the average rate of 1 rivet per minute and the cost of oxygen and acetylene for the whole job averaged $.015 per rivet.

A further use for the scarfing torch has been found in the preparation of plates for electric welding where a butt joint is required. The plates are placed with their edges together and the scarfing torch works down a line between them, cutting out a smooth even groove of any desired depth.

## NEW WIRE WELDER WEIGHS ONLY FORTY-FIVE POUNDS

A new type of butt welder for welding wire from number 4 to number 20 gauge has recently been put on the market by the Micro Products Co., Peoria, Ill. It is called the "Micro-Weld." This welder weighs only 45 lbs. and consequently is easily moved from place to place. For maximum convenience a special truck has been designed so that it can be wheeled around. It can be equipped for either 110 or 220 volts. An ingenious rotating index system built into the machine makes it possible for the operator to make the correct setting quickly and without possibility of error for the different sizes of wire. After the correct settings have been made, the operation consists only of pressing a button, the time, current and pressure being automatically controlled. The dies are closed by spring tension and the tensions for different sizes are controlled by the indexing arrangement mentioned above. The list price of this welder is $175.00.

## IMPROVED "STOODY" GRINDER

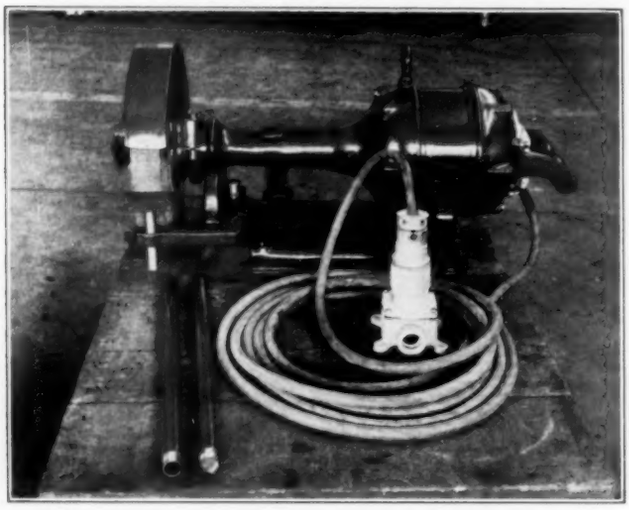
The Stoody Company, of Whittier, Calif., have placed on the market a newly designed combination grinder having all the main features of the former product as well as a number of improvements. The motor and driving-shaft housing of the new grinder, as well as the grinding-wheel guard, has been redesigned for greater strength and light weight. The motor is the same as that used in the former grinder, being rated at 2 hp., 3 phase, 220 or 440 volts, and developing a speed of 1,800 r.p.m. at 60 cycles.

For use as an aerial grinder, this latest product is provided with handle bars and is well balanced on the suspension ring. Equipped for this type of application, the grinder weighs only 167 lbs.

The stand has been completely redesigned. The grinder is held on the stand by a single clamp and hand nut. The work rest has been altered for easier adjustment and greater

stability, and the stand serves equally well for use with a disc grinding attachment.

This grinder is built rugged and strong to withstand severe



**"Stoody" Grinder With Redesigned Housing, Wheel Guard, and Stand.**

service, and it weighs complete ready for shipping only 260 lbs.

## FOUR-CORNER FLASH WELDER

A newly designed electric flash welder, for assembling four pieces into a square or rectangular framework, is shown in Fig. 1. In this illustration a door frame for a very popular make of automobile has just been welded in the machine. Fig. 2 shows this door frame before and after welding. A difference will be noticed in the area of the steel to be welded at the opposite sides of this frame.

This machine consists of four individual machines, the bases of which are slotted, tongued, and grooved to a sub-base, allowing each machine to be adjusted with respect to the

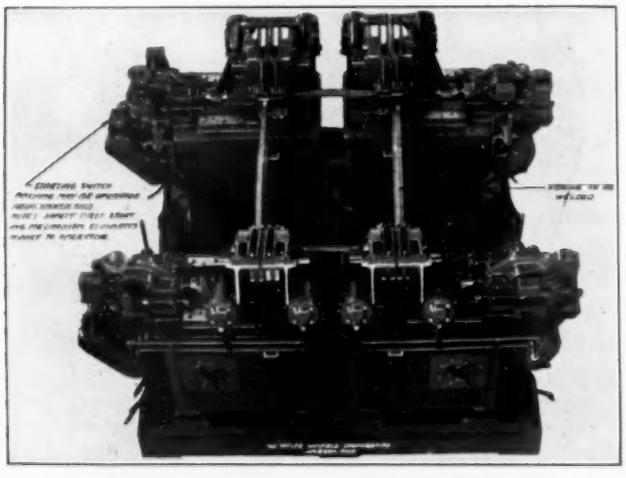


**Fig. 1. Flash Welding the Four Corners of an Automobile-Door Frame in One Operation.**

others. The sub-bases, in turn, are tongued and grooved onto the base proper, the slots allowing for movement of the sub-bases in either direction. Consequently this machine is adaptable for welding any size of frames from those on the small-size automobile to the heaviest type of door frame that could be used.

Although each machine is separate and independent of the others, they are all synchronized electrically to start, flash, upset, and retract in unison.

The work is clamped in air-operated clamping jaws, which apply pressure through a toggle action. A very great pressure is obtained with a small air consumption. The jaws operate in pairs and are controlled by air-valve switches at the side of the machine, which safety feature requires that the operator's hand be entirely from underneath the jaws when clamping. The electric switches are dual and must be interlocked from either end of the machine before the machine will operate. This necessitates that the operator be back out of the way while the machine is in action. The air clamping cyclinders are of the piston-ring design, cushioned to eliminate hammering and thus prolonging their life.

The transformers are of 25-kva. rating and are very compact in design. They are placed very close up against the

**Fig. 2. Views of Automobile-Door Frame Before and After Welding.**

work to be welded, making them very economical with regard to power consumption. Their power factor is said to be very high.

The four welders comprising this machine can be operated independently of each other should occasion arise. For example two machines could be used for welding the two corner joints on windshields, while the opposite two machines are used on other work. Each machine can be set aside in any part of the shop and operated as an independent welder, or reassembled on the base and synchronized again if desired.

This four-corner welder is made by The Taylor-Winfield Corp., Warren, Ohio, and is built for heavy duty and long life. It is said to have a production speed of 100 to 150 automobile door frames per hour.

## NEW AUTOMATIC WELDING ELECTRODE FEEDING DEVICE

The General Electric Company announces an improved feeding device on its automatic welding head to meet advances in the art of automatic welding which call for an increased use of high welding speeds requiring heavier welding currents and larger sizes of electrode wire than heretofore ordinarily used. This improvement consists of the addition of geared drive to what was formerly the idler roller in the feeding mechanism. In this way the large sizes of wire, which are stiff and hard to feed without excessive pressure on the driving rolls, are positively fed without slippage, at a regular rate and with only a moderate pressure between the driving rolls.

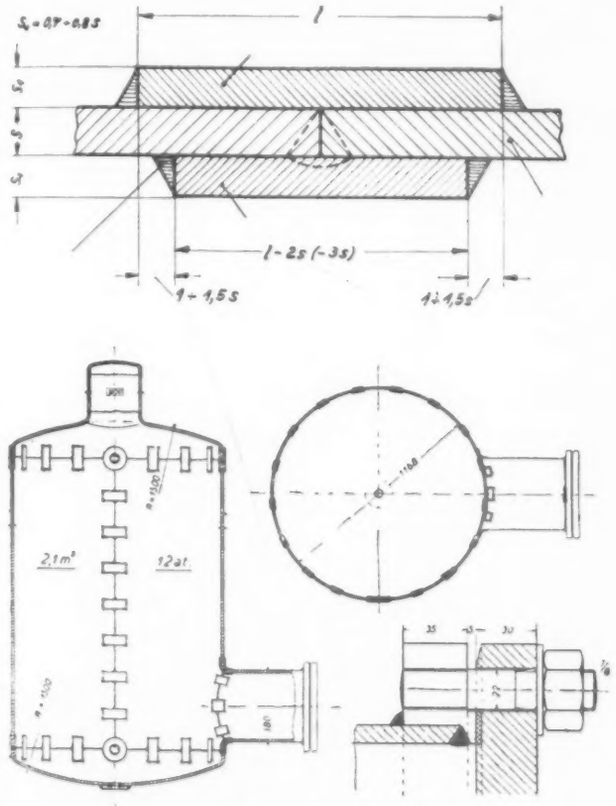
This device also extends the uses for automatic welding by making it now possible to use curved nozzles so as to reach into otherwise inaccessible places, and to weld in abnormal positions. Such cases were formerly considered impractical if not impossible on account of the difficulty of conforming the heavier wires to any other shape than their natural curvature as they come from the reel.

For the majority of applications the present practice in automatic welding requires electrode sizes from ⅛ in. to ¼ in. diameter. The improved drive roll gears furnished on heads for these normal applications will accommodate any

size wire from ⅛ in. to ¼ in. diameter without changing gears. Below ⅛ in. the gears are not needed and it is only necessary to remove one gear—that on the drive roll shaft. Sufficient pressure can then be obtained for these small sizes of wire, by screwing down the adjustment on the binding roll.

## THE USE OF BUTT-STRAPS IN BOILER WELDING

In European countries a considerable amount of promotion is being done on the subject of a patented method of using butt-straps in the construction of welded boilers. The design was invented by Mr. Hoehn, a Swiss engineer. The accompanying sketches indicate the general scheme of application of the patent. In Mr. Hoehn's opinion, it is generally preferable to arrange the butt-straps on both sides instead of on only one side of the seam. Butt-straps are of a rectangular, square or round shape, covering certain parts of the seam at regular intervals and leaving the remainder of the seam free and visible. It is reported that tests have shown the welded butt-straps to take up a good deal of the stress when the seam is




**Illustrating Butt-Strap Design for Boilers.**

put in tension, and it is pointed out that should a part of the main seam tear open, the butt-strap forms a natural limitation and prevents a progressive fracture from ruining an entire seam.

## WELDIT ANNOUNCES NEW MULTI-STAGE REGULATOR

A new Multi-Stage gas pressure regulator called the Weldit Multi-Stage Regulator has just been announced. The purpose back of the design of this new model is to produce a more satisfactory flame condition by more accurate control of the pressure and volume of the gas, without fluctuation. It is composed of two individual pressure control units known as the first and second stage. The first stage, composed of strong and rugged parts reduces the original high tank pressure to a normal working pressure. The second stage, composed of parts designed to furnish extreme flexibility, further reduces this pressure to a constant even flow of the gas to the welding or cutting torch. Ample screens prevent any foreign material from entering the regulator. A dual system of releases prevents excessive

**"Weldit" Multi-Stage Regulator.**

pressure from damaging the major parts of the regulator. It is designed in different sizes and styles for all gases used for welding and cutting.

## INDICATES ECONOMIES OF SPOT WELDING

Production welding by the spot or projection method is full of possibilities, one gathers from a reading of bulletin 270, issued by The Federal Machine & Welder Co., Warren, Ohio, and descriptive of their heavy-duty automatic spot welders. The theory of projection welding is explained, and cases are cited of its use in the welding of reinforcements on small motor supports, of outlet and switch boxes, of welding counterweights on rims, of welding the meshes of screens, and the projection welding of bumpers and other automobile parts. Figures are given of the high speeds attained by the use of these processes, and welding costs are also cited.

## ARC-WELDED CONSTRUCTION OF CRANES IS FEATURED IN PAMPHLET

On the cover page of a new pamphlet on "Cleveland" cranes appears the words "Modern Cranes by Cleveland" and the picture of a gloved hand grasping an electrode holder. Red lines running from near the tip of the electrode to the edges of the page leave a striking impression of an electric arc. The pamphlet includes views of certain parts of "Cleveland" cranes that are of one-piece arc-welded construction; these include end trucks, trolley frame, and bridge girders.

"Arc welding in place of riveting, rolled steel instead of castings —these are the features that give Cleveland Cranes the advantage of greater strength and rigidity," says the pamphlet. "Rolled steel members that compose the end trucks, trolley and bridge girders are fused into each other by the electric arc welding process so that each unit of Cleveland Cranes is actually of one piece of rolled steel—far stronger and more rigid than a one-piece steel casting of equal weight."

Arc-welded construction also permits a more efficient application of roller bearings throughout and bring operating and maintenance costs to a new low figure, so it is claimed. Moreover,

these cranes, the pamphlet says, have been tried and proven in service in every industry. Cleveland cranes are made by The Cleveland Crane & Engineering Co., Wickliffe, Ohio.

## NEW GENERAL ELECTRIC BULLETINS

The General Electric Company, Schenectady, N. Y., has recently issued three four-page bulletins giving operating details and specifications of new models of motor generator arc welding sets. Bulletin No. GEA-874 E describes the type WB-200 A arc welder, a 200 ampere machine for belt, motor or gas engine drive, stationary or portable. GEA-875 E describes a similar machine with 300 ampere capacity, especially adapted to industrial plant work or repair welding. GEA-876 D describes a third model of 400 ampere capacity. These are all single operator sets.

## NEW LITERATURE FROM ST. PAUL

A couple of very attractively prepared bulletins have recently been prepared by the St. Paul Welding & Manufacturing Company of St. Paul, Minnesota. One of these is devoted to the Torit soldering outfit which is also adapted to some uses where a small flame is desired, as it operates without oxygen or compressed air. The other bulletin describes and illustrates the Regal portable and stationary acetylene generators which are marketed by the St. Paul concern.

## NEWS OF THE INDUSTRY

The Charleston Dry Dock & Shipbuilding Company, Charleston, S. C., have recently completed the construction of an all-welded tanker which has received a considerable amount of attention from the shipbuilding industry during the past few months. The plate work is mostly $\frac{5}{8}$ in. and $\frac{3}{8}$ in. plate. The equipment used for its construction consisted mainly of one cutting torch and one G. E. R. welding machine.

At a meeting of the American Society of Mechanical Engineers held at Worcester, Mass., January 8th, J. R. Weaver, superintendent of the Manufacturing Equipment Department of the Westinghouse Electric & Mfg. Company, read a paper on the subject: "New Methods of Building Machine Tools, Jigs and Fixtures by Means of Arc Welding."

The Oliver H. Van Horn Company, New Orleans, La., have opened a branch store in Shreveport, La., under the supervision of Mr. Percy F. Richards. The new store will handle the Smith line of oxy-acetylene welding and cutting equipment.

The subject of the January meeting of the Cleveland Section of the American Welding Society, scheduled for January 17th, is "Arc Welding Oil and Gas Lines." Motion pictures and a paper on this subject will be presented by A. F. Davis, vice-president of the Lincoln Electric Company.

Word has been received that R. E. Fritsch, vice-president and sales manager of Tube-Turns, Inc., Louisville, Ky., will speak on "Pipe Welding With Stock Fittings," at the convention of the Gas Products Association which is being held in Chicago, January 20th to 22nd.

Rodney B. Swift, formerly connected with the American Brass Company, has recently been added to the sales force of the Weldit Acetylene Company, with headquarters at the home office of that company in Detroit.

It is with deep sorrow we report that Mr. Frederick W. Flint, who was secretary and treasurer of the K-G Welding & Cutting Company, from 1916 until March, 1929, when he resigned his position, died suddenly at his home on December 25, 1929. At the time of his death, he was a director of the K-G Welding & Cutting Company.

On January 22nd, at 7:00 P. M., the Western Society of Engineers, Chicago, will hold a group meeting on the subject of "Welding of Steel Structures." The meeting will consist of an informal discussion of design features for welding. The meeting will be held in Room 1200, 205 W. Wacker Drive.

The Milwaukee Welded Steel Corporation, 1350 Burnham Street, which was established last year, has been making steady progress in the fabrication of welded metal articles and is now sending out announcements of a number of welded products which they fabricate and sell.

The Ohio Valley Oxygen Company completed recently a $40,000 two-story addition to its Cincinnati plant, providing space for a larger charging room, shipping room, new office, laboratory and stock room. A large assembly room for dealers' and salesmen's meetings is a feature of the new office. A shipping platform 10 feet long and 66 feet long with yard space for trucks all under a roof 30 feet deep is a feature of the new shipping department. A 50-foot driveway runs through to the next street in back of the plant. It is announced that a large increase in production will be effected by the installation of additional machinery very soon.

Alexander F. Jenkins, president of the Alexander Milburn Company, has returned to Baltimore after an extended tour of Europe and the Near East, having visited England, Italy, Egypt and Palestine. A considerable part of the time was spent in a cruise up the Nile.

The Weldit Acetylene Company, Detroit, Mich., announces the appointment of two divisional sales managers. J. W. Keyes, in charge of the northern group, will direct sales in all territory north of the Ohio River and east of the Mississippi River. J. B. Manor will be in charge of all sales south of the Ohio River and east of the Mississippi.

The National Oxygen Company, with plants at Chicago, St. Louis, Logansport, Detroit and Akron, has recently been elected an active member of the Gas Products Association.

L. W. Chubb, manager of the Radio Engineering Department of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has been appointed first assistant to the vice-president in charge of engineering of the new Radio Victor Corporation of America. His headquarters will be in Camden, N. J. Mr. Chubb has been responsible for some interesting developments in the welding field, one of these developments being the use of electric percussive welding in making vacuum tubes.

The Burdett Oxygen Company, Cleveland, Ohio, have recently announced that it was planning the construction of a $200,000 addition to its plant at 3300 Lakeside Avenue, N. E. Wm. H. Loveman is president of the company.

A recent report of the membership of the Gas Products Association shows a total of 38 oxygen plants and 40 class B members.